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EDITORIAL

BARIUM SULPHATE.

Of recent years this chemical has come into considerable use. Its particular field of usefulness has been in rœntgenological practice. Previous to its introduction the bismuth compounds had been used to supply imperviousness to the passage of the X-ray so that organs coated with the chemical reflected their outlines or defects in their outlines on the developed negatives. But the bismuth compounds were expensive, and minds were promptly turned to search for some innocuous and inexpensive substitute to replace these costly compounds. Of the host of substances which presented themselves, barium sulphate was selected and under some conditions proved to be quite the happy choice. It is, however, painfully true that deplorable errors have been made in many instances in connection with dispensing this substance. A recent fatal mistake is reported in the English press, which recounts how barium thiosulphate, also known as barium hypo-sulphite, had been administered instead of the sulphate, and had occasioned the prompt death of the patient to whom it had been furnished. (See *Pharmaceutical Journal and Pharmacist,* October 22, 1921.)

On this side of the water barium sulphide, the depilatory, has often been given in error for the insoluble sulphate, and frequently with fatal results. All of these mistakes have occurred when the chemical in question had been prescribed for the purpose of affording X-ray diagnosis. Those who are familiar with procedures involving the use of these impervious materials for rœntgenology know that the custom is to administer to the patient a quantity of the chemical ranging from 100 to 150 grammes suspended in water or preferably milk. Then, after the customary delay, the exposure is

made and the impervious material is allowed to follow the usual course of passage through the body canals. It naturally follows that only an insoluble and innocuous compound can be safely used for this purpose because of the enormity of the bulk dose and also because of leaving the material in the digestive organs until it is disposed of by natural processes. Pure barium sulphate is practically insoluble in water and in dilute acids, and from that viewpoint can be used with impunity for the stated purpose. Pure barium sulphate is easily procurable from the responsible chemical manufacturers if the purchaser is satisfied to pay a slightly increased price, but there is much of this material placed upon the market today and offered at lower figures than the pure compound which is totally unfit for this diagnostic purpose.

Knowing the comparative toxicity of the soluble compounds of barium and also knowing that variable and unscientific modes of manufacturing this chemical might by occlusion or otherwise contaminate the precipitated sulphate with soluble compounds of barium or other bases, the need for watchfulness and eternal care in using suspicious samples is very manifest.

We have recently encountered samples of the so-called X-ray barium sulphate that emitted the familiar odor of hydrogen sulphide, and we recall one instance where a hospital laboratory submitted to us a compound, the manufacturing source of which was not specified, that was possessive of this odor to an unusual extent. This particular sample carried with it the reputation of having caused much discomfort to a series of patients to whom it had been administered and a good deal more discomfort to the rœntgenologist who had used it. A cursory examination of it revealed the presence in the dried material of about three-tenths of one per cent. of water soluble residue, which was composed in the main of calcium sulphate and of sulphides of zinc and calcium, impurities which were probably due to the manufacturing process. Assuming that one-half of this residue consisted of the sulphides of zinc and calcium, one can readily see that a patient to whom is administered 150 grammes of the compound receives of these sulphides a unit dose approximating .275 gramme, or about 4 grains, a dose which, while not toxic, is at least nauseating.

The sulphides of barium, were they present in a like proportion would certainly lead to more serious results, but it is hardly

likely that these compounds are present from manufacturing defects. It has been said, however, that long storage of the barium sulphate under some conditions would lead to a reduction of some of the sulphate into the sulphides. That in the presence of dampness and organic contaminants certain bacterial agents are able to reduce small amounts of the sulphate to the several sulphides is the opinion of a scientist who was consulted with in this matter. Another propounded the theory that moisture alone could effect changes in the composition of this chemical.

Summing up, these facts remain clear. In the first place that as long as this chemical is not included in the present revision of the United States Pharmacopœia so that adequate protective tests might be consulted and used, those utilizing this as their impervious agent should be particularly meticulous in regard to its source, its purity and its storage. In the second place, the product of reputable manufacturers should be specified and along with these specifications should be added the designation upon the order sheet, "Barium Sulphate, Pure, for X-ray purposes." Any samples giving an odor of the sulphides should be viewed with suspicion and shouid not be administered to patients, except after previously thoroughly washing in dilute acid and water. Also this material should never be stored except in dry containers and in a dry place.

I. G.

ORIGINAL PAPERS

LACTOMETER AND FAT IN MILK CONTROL.*

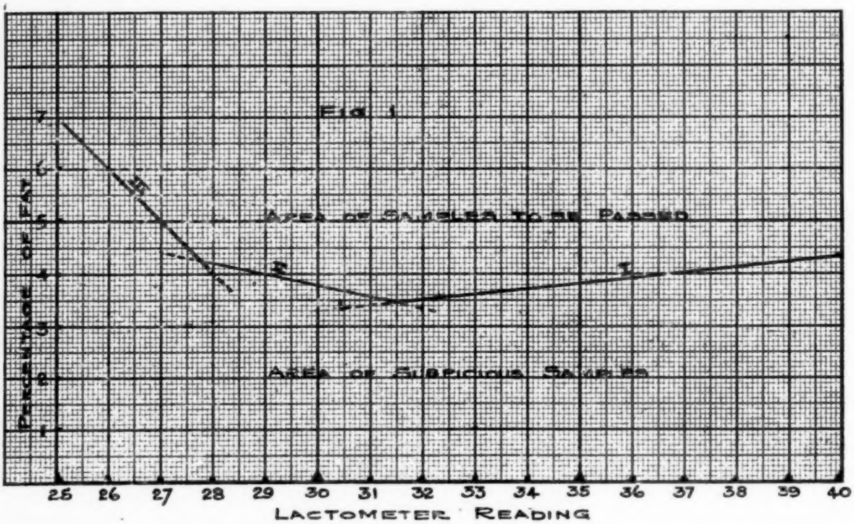
By David Wilbur Horn, Ph. D.

This paper calls attention to a method for using jointly the lactometer reading and the butter-fat content of a milk directly as the bases for sorting out skimmed, watered, and sub-standard milks. This method is for preliminary use in routine examinations of so-called *herd milks* or *market milks*. It is logical that the lactometer reading and the percentage of fat should serve directly to guide the

*Read before the Delaware County Institute of Science, Media, Pa., May 9, 1921.

later detailed work because these are the values determined at the outset in routine milk work.

In States that, like Pennsylvania, have expressed in the statutes[1] minimum legal percentages of fat and total solids, and that do not provide additional penalties for skimming and watering,[2] the analyst does well to confine his evidence to data showing the milk in question to be sub-standard. It is worth while in such States to establish that a suspected milk is skimmed or watered only in those cases where the percentages of fat and of total solids are



above the legal minima. The method suggested in this paper embodies this idea.

In normal mixed milks the constituents are present in fairly constant proportions. The relations between various constituents have found expression in numerous *milk formulæ*[3] some of which

[1] Milk and Cream Act, approved June 8, 1911, forbids the sale of "milk which contains less than three and one-quarter (3¼) per centum of butter-fat, and less than twelve (12) per centum of milk solids," etc.

[2] In the State of Massachusetts, the penalty for the sale of milk which is adulterated is more severe than for the sale of milk below the legal standard." Lythgoe, *Jour. Ind. Eng. Chem.*, VI, p. 900, 1914. See also, *Journ. Off. Agr. Chemists,* August, 1921.

[3] These may be found in various text-books Among the more valuable of the recent formulæ are those due to Lythgoe (footnote 2) resting upon the total solids, the sugar, the fat and the ash, which may be used in distinguishing

are so generally used that instead of the analyst going to the formulæ themselves or to a table of values derived from them, slide rules are available for the necessary calculations.[4] Some of the milk formulæ that are most extensively used date back thirty to thirty-five years and have survived the scrutiny of critics and the proof of practice. Two formulæ of which this may be said are (1) the formula [5] connecting the percentage of total solids T with the lactometer reading L and the percentage of fat F:

$$T = \tfrac{1}{4}L + \tfrac{6}{5}F = 0.25L + 1.2F \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

and (2) the formula [6] connecting the mean specific gravity of the total solid matter *m* with the specific gravity of the milk G and the percentage of total solids T contained in it. The removal of fat or the addition of skimmed milk raises this mean specific gravity; the first, because it removes some solids that are lighter than water, the second, because it increases the proportion of solids that are heavier than water. The relation between this mean specific gravity of the solids and the other values in a milk can be and has been clearly demonstrated to be quantitative.[7] This relation has

between pure and adultered milk. As in the early use of most milk formulæ, "subsequent experiences (between 1909 and 1914) showed that "for practical purposes" certain changes were desirable in the application of them.

[4] Richmond's "Milk Scale" and Ackermann's "Automatic Reckoner."

[5] This simple form is often called Richmond's, or Richmond and Hehner, or Babcock's formulæ. As a matter of fact it is a simpler form of expression that became apparent when more complicated formulæ were applied and the tabulated results then compared. See Richmond's *Dairy Chemistry*, 2d Ed., 1914, p. 69; and Shaw and Eckles, Bull. 134, U. S. Dept. Agr., Bur. of Animal Ind., 1911. Richmond and Hehner's formulæ (*Analyst, 13*, p. 26, 1888), $T = 0.254\ G + 1.164\ F$. which approximates closely to $T = \tfrac{1}{4}\ G + \tfrac{6}{5}\ F$ Richmond later derived a new formula because the previous formulæ "were derived from analyses to which objection could be taken"; so that Richmond's formula is $T = 0.2625\ \frac{T}{G} + 1.2\ F$, which has been found to be expressed by the simpler formula, $T = \frac{G}{4} + \frac{6}{5} F + .14$; and this is the formula on which Richmond's milk scale rests. In this country it is customary to drop the constant, as suggested by Patrick (see Leffman, Analysis of Milk and Milk Products 1915, p. 21); and after so doing, the formula is frequently called Babcock's formula. Babcock's papers are in the 8th and 12th Ann. Rep. Wisconsin Agr. Exp. Sta., 1891 and 1895. See Allen's *Com. Org. Anal.*, 4th Ed., Vol. VIII, p. 163.

[6] Known as Fleischmann's formula, which dates back in its beginnings to 1882-85 (*Jour. für Landwirtschaft, 30*, p. 293; *33*, p. 251.).

[7] For demonstration, see Richmond's *Dairy Chemistry*, p. 64.

been thus expressed:

$$m = \frac{GT}{GT - (100G\text{-}100)} \quad \ldots\ldots\ldots\ldots \quad (2)$$

The numerical value of *m* ranges from 1.2 to 1.4, depending upon the ratio obtaining in any given milk between the fat and the non-fatty solids. It does not exceed 1.34 in mixed milks beyond suspicion of skimming.[8] If therefore the value 1.34 be substituted for *m* in equation (2), thus,

$$1.34 = \frac{GT}{GT - (100\ G - 100)} \quad \ldots\ldots\ldots\ldots \quad (3)$$

an equation (3) is obtained that defines the minimum values of G and T that will be met with in mixed milks which may in routine examinations be passed as unskimmed.

Formulæ that serve to bring out probable skimming are more generally useful in routine work than other milk formulæ. The writer's experience leads to the conclusion that in 1920 in the suburban area from which the market milk samples (upward of a thousand) examined by him were drawn, skimmed milk was from thirty to forty times as common as watered milk or as sub-standard milk. This is largely due to the fact that the larger dealers practice skimming in one form or another under the name *standardization.*[9] Therefore the first and most important step in developing the sorting method herein proposed was to obtain a formula involving only the lactometer reading L and the fat per cent. F, by which milks suspicious of skimming would be indicated.

Such an equation was developed algebraically from (1) and (3). In the development it is necessary to make use of the fact that the lactometer reading L, expressed as it usually is in degrees on the Quevenne lactometer scale, bears the following relation to the specific gravity G of the milk (provided both readings are at the standard temperature, 60° F.):

$$L = 1000G - 1000, \quad \ldots\ldots\ldots\ldots \quad (4)$$

whence,

$$G = \frac{L + 1000}{1000} \quad \ldots\ldots\ldots\ldots \quad (5)$$

[8] See Van Slyke, *Modern Methods of Testing Milk and Milk Products,* 1907, p. 140; and Woodman, *Food Analysis,* 1915, p. 139.

[9] See Parker, *City Milk Supply,* 1917, p. 261.

Transforming equation (3), it may be made to assume the form,

$$T = \frac{3.941\ (100\ G - 100)}{G} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

Substituting into (6) the value for G from (5), equation (3) finally may be made to assume the form,

$$T = \frac{394.1\ L}{L + 1000} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

Equating the values for T as given in (1) and (7), one obtains

$$\frac{394.1\ L}{L + 1000} = 0.25\ L + 1.2\ F \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

which reduces to

$$F = \frac{328.42\ L}{L + 1000} - 0.2083\ L \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

This formula meets the requirements of the case since it involves only the lactometer reading L and the fat per cent. F, and by it mixed milks suspicious of skimming will be indicated.

Another formula that the writer has used as a check upon the numerical results from (9), was developed by substituting the value for L as given in (4) into equation (1) and then equating the right hand member of the resulting equation, which is,

$$T = \frac{5\ (100\ G - 100)}{2} + \tfrac{6}{5}\ F \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (10)$$

with the right hand member of equation (6). After simplifying one then obtains the formula

$$F = \left(\frac{3.284}{G} - 2.083\right)(100\ G - 100) \quad \ldots\ldots\ldots\ldots \quad (11)$$

The numerical results calculated by each of these formulæ are given in the following table. The values found thus for F have been rounded off so that they might not exhibit fictitious accuracy.[10]

[10] "The fat calculated from the specific gravity and total solids almost invariably *agrees within 0.2 per cent.* with the determination made by the appropriate method." Richmond, *Dairy Chem.*, p. 69.

TABLE I.

Specific gravity at 60° F.	*Lactometer reading at 60° F.*	*% fat calculated by formula (9)*	*% fat calculated by formula (11)*
1.025	25	2.8	2.8
1.026	26	2.9	2.9
1.027	27	3.0	3.0
1.028	28	3.1	3.1
1.029	29	3.2	3.2
1.030	30	3.3	3.3
1.031	31	3.4	3.4
1.032	32	3.5	3.5
1.033	33	3.6	3.6
1.034	34	3.7	3.7
1.035	35	3.8	3.8
1.036	36	3.9	3.9
1.037	37	4.0	4.0
1.038	38	4.1	4.1
1.039	39	4.2	4.2
1.040	40	4.3	4.3

Upon inspection of this table, a surprisingly simple relation between the lactometer reading and the fat per cent. becomes evident. The numerical values for the fat may be obtained by adding 3 to the lactometer reading and then dividing by 10. This is expressed by a much simpler formula than either of those originally used to calculate the values of F set forth in Table I:

$$F = \frac{L + 3}{10} \qquad (12)$$

From the derivation of formulæ (9) and (11), and hence of this simple formula (12), it follows that any one of the fat values calculated by formula (12) is the lowest or minimum fat percentage to be expected in an unskimmed mixed milk that has exhibited the corresponding lactometer reading. As an example of the use of this formula, consider a mixed milk found to have a lactometer reading of 32; the minimum fat per cent. in such a milk if it is above suspicion of skimming is

$$(32 + 3) \div 10 = 3.5\%.$$

Should the milk be found by actual analysis to contain less than 3.5 per cent. it should be set aside for further consideration because it is not above suspicion of being skimmed.

A rule so simple is easily remembered, and applied without written calculations: *Add 3 to the lactometer reading and then divide by 10. The result is the minimum percentage of fat in a mixed milk above suspicion of being skimmed.*

This rule has its limitations. One limit to its use as a guide in sorting out milks that merit detailed examination can readily be shown when the line representing the minimum legal standards in Pennsylvania [11] is plotted on the same axes with it. To obtain the values necessary for plotting this line, equation (1) may be transformed as follows:

$$T = \tfrac{1}{4} L + \tfrac{6}{5} = 12\%$$

whence,

$$F = 10 - 0.20833\ L \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (13)$$

The values in the following table have been calculated by use of this equation (13):

TABLE II.

Lactometer reading at 60°	*% fat calculated by formula (13)*
27	4.4
28	4.2
29	4.0
30	3.7
31	3.5
32	3.3
33	3.1

Any of these calculated values of F is the least or minimum fat percentage to be expected in a (legal) standard mixed milk that has exhibited the corresponding lactometer reading. As an example, consider a mixed milk found to have a lactometer reading of 31. The minimum fat per cent. in such a milk if it is above (legal) standard, *i. e.,* if it contains not less than 12 per cent. of total solids, is 3.5 per cent. Should this milk upon analysis show less than 3.5 per cent. fat, it should be set aside for further consideration because it is not above suspicion of being sub-standard.

When the numerical values in Table I and II are plotted on the same axes, the lines marked I and II respectively on Fig. I are

[11] See footnote No. 1.

obtained. The intersection of line II with I shows where the legal standard in Pennsylvania limits the use of the skimming rule. In the writers opinion it is much better practice in Pennsylvania for the analyst to limit himself in all possible cases to establishing that a given adulterated milk is sub-standard rather than to base the legal action upon the charge of skimming.

Another limit to the use of the skimming rule as a guide in sorting out mixed milks that merit detailed examination could also be readily shown were it possible to lay off on the same axes a line, III, representing the limits separating the watered milks from the unwatered milks, among those that lie above the legal standard. Here the data are less satisfactory than in the two other instances. But the writer has used, tentatively at least, a suggestive formula due to Bialon.[12] It may be urged with reason that it does not rest upon American experience, but Bialon's formula may be not only suggestive but also useful to some degree until such time as American experience may have shown that Bialon's constant for the gravity of unwatered fat-free milks is different from or is the same as the corresponding constant exhibited by the outputs of large numbers of American herds.[13]

Bialon's formula is

Specific gravity of the fat-free milk,

$$M = \frac{100\,G - F}{100 - F/0.933} \quad \text{(14)}$$

He places the lowest gravity in unwatered fat-free milks at the figure 1.0323, hence for the poorest unwatered milks his formula may be written

$$1.0323 = \frac{100\,G - F}{100 - F/0.933} \quad \text{(15)}$$

Substituting in equation (15) the value of G as given in (5), and reducing, Bialon's formula becomes:

$$F = 969.927 - 939.579\,G \quad \text{(16)}$$

The values in the following table have been calculated from this equation (16):

[12] *Milchwirtschaftliches Zentralblatt,* I, 1905, p. 363. See Barthel, *Die Methoden zur Untersuchung von Milch und Molkerei Produkten,* 1911, p. 134.

[13] As already suggested in footnotes Nos. 3 and 5, practically every milk formula has been put forth first in a form that was tentative or was later modified.

TABLE III.

Lactometer reading at 60° F.	*% fat calculated by formula (16)*
26	6.0
27	5.0
28	4.0
29	3.0
30	2.0

When by the aid of the data in Table III, a line III, is laid off on the same axes as were previously used (see Fig. 1), the intersection of line III with line II shows within what limits Bialon's formula is suggested for use in the method herein proposed. Within these limits, any calculated value of F is the least or minimum fat percentage in a mixed milk that is above suspicion of watering and that has exhibited the corresponding lactometer reading. As an example, consider a milk found to have a lactometer reading of 27. The minimum per cent. of fat in such milk if it is above suspicion of being watered is 5 per cent. Should this milk by actual analysis be found to contain less than 5 per cent. of fat, it should be set aside for further consideration.

Considering now the completed graph shown in Fig. 1, the area that lies above the broken curve formed by the intersection of lines I, II and III contains all pairs of values of lactometer and fat to be found in the mixed milks that in routine work may be passed by the analyst. The area below the broken curve contains the rest. Hence in the course of routine milk examinations if the values found for L and F be located by the analyst on Fig. I, it becomes a simple matter to set those milks that are suspicious apart from those that may be passed.

It is not essential that a Quevenne lactometer be used in the work, although it is more convenient.[14] The specific gravity can be found more accurately and almost as quickly with a Mohr-Westphal specific gravity balance. The result thus obtained is readily converted into Quevenne degrees by formula (4). Since $L = 1000\ G - 1000$, then, for example, if the gravity is found to be 1.029 the corres-

[14] An excellent form of Quevenne lactometer is that recommended by Shaw & Eckles, l. c. footnote 5; but it contains no thermometer. The common form in use is an improvement made by Müller on the original Quevenne lactodensimeter. See Müller, *Prüfung der Kuhmilch*, 1877.

ponding Quevenne reading will be 29. The figure for the specific gravity thus gives at a glance the corresponding Quevenne figure. But no Mohr-Westphal balance outfit should be depended upon until it has been proved to meet the following requirements: (1) the weights of the riders must be in the proportion of 1 : 10 : 100 : 1000; (2) the divisions on the beam must be at equal intervals; and (3) the outfit must show in water of some known temperature the density water is known to possess at that temperature.[15]

If a New York Board of Health lactometer [16] is used, its reading need merely be multiplied by 0.29 in order to learn the corresponding Quevenne reading, for 100° Board of Health = 29° Quevenne.

In any event, fluids of known specific gravity should be available for calibrating the instrument used. In dealing with this matter, a most important point to be borne in mind is that while most specific gravities are referred to water at 4° C., lactometer readings relate to gravities at 60° F. referred to water at 60° F.[17] When the centigrade scale is used, the density $D^{60°F.}_{60°F.}$ is usually taken as identical with the density $D^{15°C.}_{15°C.}$. The writer has found solutions of sulphuric acid and solutions of sugar useful for such calibrations.

Sulphuric acid is better adapted to use by a chemist than by others. It is desirable to be able to prepare solutions by their normalities, such that their specific gravities will correspond to certain points on the lactometer scale. To this end I have calculated the values for the constants in the following approximation formula within the range of specific gravities from 1.014 to 1.041:

[15] Kohlrausch, Tr. *Physical Measurements*, 1894, p. 45.

[16] This is sometimes called the Spence scale. "The two fixed points on the scale of this instrument are the 0° mark which is at 1.000 the specific gravity of pure water, and the 100° mark which is set at 1.029, the minimum gravity of milk. The graduations are continued to 120° and 130°. The point 1.029 which was long ago fixed in Europe as the limit of the density of genuine healthy milk was redetermined in 1875 and 1876 by the health authorities of New York and New Jersey, from actual experiments at the dairies. Out of 1600 cows whose milk was examined, only six, two of whom were sick at the time, were found to give milk below that figure." Pellew, *Man. of Prac. Med. and Physiol. Chem.*, 1893, p. 178. Every degree below 100° was supposed to represent one per cent. of added water. No such interpretation of the reading of the Spence scale is today acceptable.

[17] The correction for temperatures other than 60° F. may be gotten from any book dealing with milk analysis; for example, Leffmann's Milk Analysis, cited in fotnote 5.

$$N = A + dB + d^2C + d^3C + d^4E + \ldots\ldots\ldots$$

where N = the normality of the sulphuric acid

d = the specific gravity $D^{15°C.}$

A = —297.800

B = +916.349

C = —1047.430

D = +506.431

E = —77.5467

It it better to use a six-place logarithm table in applying this approximate formula.

For more general use, cane sugar is suggested, because in the form of the best grades of granulated sugar it is easily obtainable and is cheap. A solution of any desired percentage can readily be made by weighing off the proper quantities of sugar and water.

In Table IV are given the proper normalities of sulphuric acid and the proper percentages of sugar for obtaining solutions for use in calibrating, such that they will have specific gravities located at every five degrees along the Quevenne scale. The normalities of the sulphuric acid were arrived at by application of the approximation formula already given, after deriving it from the table to be found in Landoldt, Bornstein, Meyerhoffer *Phys. Chem. Tabellen,* page 326. The percentage of the sugar solutions were worked out from the same source, page 364, checked by values in *Tables Annualles Internationales de Constantes et Donées Numériques,* page 17. In all of these operations due attention was given to the fact that the tables give densities that are not on the same temperature basis as the densities of milk (otherwise table 10, p. 389, Methods of Analysis Of. Agr. Chemists, 1919, could be used). After sugar solutions have been made, if there is any doubt about them they may of course be checked by the polarimeter or by the refractometer.

TABLE IV.

Specific gravity at 15° C.	*Lactometer reading*	*Normality* of *sulphuric acid*	*Percentage of sugar solution*
1.0200	20	0.618	5.065
1.0250	25	0.771	6.307
1.0300	30	0.929	7.537
1.0350	35	1.087	8.755
1.0400	40	1.240	9.963

SUMMARY.

A direct method has been described for sorting mixed (herd or market) milks into two classes, those probably adulterated or sub-standard and those probably neither adulterated nor sub-standard. The kinds of adulterated milks considered are those that are skimmed and watered. The method gives preference to the establishment of sub-standard character whenever possible, with skimming and watering as abuses to be dealt with by detailed analysis only when the adulterated milk is above the legal standards. The simplest way to use the method is graphically,[18] though a very simple skimming rule is given for use within certain limits. The fundaental values in the method have been arranged to be the lactometer and the fat, because they are the two values determined at the outset in routine work. A table is given for the calibration of lactometers.

SCHOOLS OF PHARMACY AS PRE-MEDICAL SCHOOLS.*

By Horatio C. Wood, Jr., M. D.

Professor of Materia Medica at the Philadelphia College of Pharmacy and Science.

Forty of the States in our Union demand as a prerequisite to the study of medicine one or more years of "college education," *i. e.*, a study of subjects beyond the high school standard. It is specified in many of these laws that this education must be acquired in a "college of arts and science." Although the wording of this section of the laws is sometimes ambiguous the manifest purpose of

[18] The graph as given in Fig. 1 can readily be modified for use in States which, like New York and New Jersey, fix the minimum legal limit for total solids at 11.5 per cent. instead of 12.0 per cent., as in Pennsylvania. The only effect of the change will be to drop the line II to a position parallel to its present one but nearer to the origin of the axis. Similarly, line III can be moved nearer or further from the origin as experience may dictate. Neither of these changes modifies the principles upon which the proposed method rests. For practical use in the laboratory, the graph is best plotted from Tables I, II and III upon paper cross-ruled in inches and tenths of inches.

*Read before the Philadelphia Branch of the American Pharmaceutical Association.

it is to exclude those schools where professional preparation has been the prime purpose. The University of Pennsylvania says: "Time spent in professional schools of law, dentistry, pharmacy, etc., will not be accepted as the equivalent of any part of the two years of college education."

I should like to have you consider with me for a little while this evening whether this discrimination against schools which teach pharmacy is a wise one.

REASONS FOR COLLEGE EDUCATION.

Before undertaking this investigation we should have a clear idea of why collegiate preparation is desirable for the study of medicine. As I see it there are three fundamental reasons.

First.—Weeding out the mentally incompetent. In an interesting article in the *Scientific Monthly* (January, 1921) Professor Pillsbury, of the University of Michigan, points out that the modern educational system has a "very important function as a selecting agency, a means of separating the men of best intelligence from the deficient and mediocre. All are poured into the system at the bottom; the incapable are soon rejected or drop out after various grades and pass into the ranks of unskilled labor . . . the more intelligent who are to be clerical workers pass into the high school; the most intelligent enter the universities, whence they are selected for their professions." There can be no doubt that the amount of education a man can acquire is limited by his natural endowments. There are types of intellect, amply sufficient for the requirements of swinging a pick-axe or shoveling coal, to whom an asymmetric carbon atom would remain a mystery even after forty years of study. It is manifest that a man with insufficient degree of intelligence to pursue a course at college can never reach high success in the practice of medicine.

Second.—Advantage of a certain degree of familiarity with what are called "cultural" subjects. A man may be able to cure malaria without ever having read Shakespeare, but he is certainly limited in his outlook on life and, I believe, in his usefulness to the community unless he has some acquaintance with English literature.

It is highly improbable that he who has never read any of the standard masterpieces will ever develop a good literary style either in speaking or writing. When I say "good literary style" I mean the power of expressing himself so as to convey his meaning clearly and forcibly, not merely to charm the ear. If a man be ignorant of history he cannot properly interpret modern trends either in his profession or in the world in general and there is certainly a crying need in the medical profession today for men whose feet are held to the ground by a knowledge of the fads of the past. But I am not here to argue for the value of general culture as a professional asset; I can only say that, like the great majority of professional educators, I am firmly convinced of it.

Third.—The third, and probably most important reason for the pre-medical course is to provide a knowledge of certain branches which are fundamenal to the medical sciences.

COMPARATIVE ADVANTAGES OF SCHOOLS OF ARTS OR OF PHARMACY.

Let us consider the advantages of the present pharmacy course as a preliminary for the medical course under these three divisions.

First as a mode of selection of the mentally fit. The value of the present pharmacy course as a means of separating men into their intellectual or psychological groups seems to me at least equally high, if not higher, than that of the ordinary college curriculum. The subject of materia medica is as good a test of a man's memory power as that of history. Organic chemistry requires a degree of logical reasoning of as high a type as that in trigonometry or calculus. The man's powers of observation, as well as his control over finer muscle movements, are fully tested in the chemical and pharmaceutical laboratories. I might digress a moment to point out that motor control, *i. e.*, the power to guide accurately the finer movements of the hands, is regarded by psychologists as an important test of intellectual capacity and is an essential quality both to the student and practitioner of medicine. The success of the medical student in anatomy, physiology, pharmacology and chemistry is very largely conditioned on his ability to perform delicate manipulations.

The second advantage of a pre-medical college training is a widening of the mental horizon that comes only from knowing something of matters beyond the realm of our daily occupations. The relative value of various studies for this purpose is a matter of per-

sonal opinion, but I wish to point out that the differentiation of a purely cultural subject rests primarily upon the fact that it has no immediately apparent usefulness in assisting a man's professional activities. Whether a subject is a cultural one or a utilitarian one depends very largely upon what the student's future career is to be; for example, a knowledge of trigonometry is of no immediate advantage to a practicing physician but is essential to the engineer; to the one it is a matter of general educational interest, to the other it means bread and butter. To the business man Grecian history is purely an ornamental acquirement but to the artist it is almost a professional requisite.

While some of you may differ, the subjects which seem to me pre-eminently suitable as educational ornaments for the physician are rhetoric and history. I also believe that he should be well grounded in at least two foreign languages, one ancient and one modern, and that a knowledge of higher mathematics, as trigonometry and calculus, is valuable. I do not wish to infer that other subjects such as geology, psychology and botany may not be of value as educational embellishments but they are rather too closely related to the professional subjects to be considered as purely ornamental.

It is very manifest that the ordinary two-year course in pharmacy is so hopelessly deficient in these branches that it lies outside of all comparison with the academic institutions. There has recently been, however, a strongly manifest tendency on the part of colleges of pharmacy to enlarge the scope of their work, and a number of them have instituted courses covering four years of study and leading to a degree of Bachelor of Science in Pharmacy. In these institutions are being offered, although not in so abundant variety as in the academic colleges, courses covering the more essential topics of a liberal education such as English, French, German and mathematics.

The third reason for requiring a collegiate education is that there are certain branches fundamental to the medical sciences, which are no longer taught in medical schools, which are essential to understanding of the medical subjects. For example, it is manifestly impossible for a student to follow the course in physiological chemistry, which is usually given in the first year of medical curriculum, unless he has an acquaintance with general chemistry.

That this is the most important reason for pre-medical training is shown by the fact that a knowledge of the same fundamental branches is required, not only by the Council on Education of the

American Medical Association, but practically all the medical schools in the country and also by the laws governing medical practice in a majority of the States in the Union.

Thirty-six of the United States require two years of college education as preliminary to the study of medicine, and four others require one year of college education. Of thirty-one States, of whose requirements I have record, twenty-seven specify that a portion of this preliminary education must be devoted to the subjects of physics, chemistry and biology and sixteen of them include also a modern language. In only four of these thirty-one States is there no restriction as to the subjects to be studied. The rules of the Council on Education of the American Medical Association require, in addition to a high school education, two years in an "approved college of arts and science" which must cover a minimum sixty semester hours and include a certain number of hours in specified subjects. These are shown in Table No. 1, column 1. In addition to the obligatory subjects mentioned in this table the Council on Education "strongly urge" that a portion of the elective time be devoted to a foreign language, botany, zoology and psychology.

As an example of requirements which are distinctly in excess of the minimal outlined by the Council on Education we may take the entrance requirements of Johns Hopkins University. There are other schools in the country whose entrance requirements are as high or even more strict than that of Johns Hopkins but I have chosen this school because, while it does not insist upon a collegiate degree, it requires an amount of preliminary education which cannot be finished in two years. The conditions for entrance into Johns Hopkins University Medical School are shown in column two of the table.

In order to ascertain how nearly these conditions of preliminary education may be fulfilled in a college of pharmacy, I have summed up the amount of time devoted to the various subjects which are either requisite or highly desirable as a preliminary to medical study, in the first two years of three schools of pharmacy which offer a four-years' course leading to the degree of Bachelor of Science in either pharmacy or chemistry. The curricula of these three schools, which are fairly typical, have been tabulated in the columns marked 1, 2 and 3 in the table.

TABLE I.

	A. M. A.	*J. H. U.*	*1*	*2*	*3*
Physics	8	10	8	8	8
Chemistry	12	15	38	23	18
Biology	8	11	†10	0	0
Foreign Language	*6-12	A	10	12	8
English	6	0	10	6	4
Pharmacy	0	0	10	8	11
Botany	*3-6	0	0	4	2
Pharmacognosy	0	0	0	4	9
Mathematics	*3-6	0	6	6	4
Others	26	B	8	0	2
Totals	60		100	71	66

It will be noted in the above table that the courses in all these schools meet or exceed the minimal requirements of the Council on Education except in the subject of biology, and in one school also in English. In school No. 1, which apparently meets all the requirements of the A. M. A., it is impossible to ascertain from the catalogue whether or not it meets the requirements in biology because no separation is made between the amount of time given to biology and to botany. While botany, strictly speaking, is a branch of biology, the Council on Education draws a line between general biology, botany and zoology; the rules state that the requirements in biology may be "satisfied by a course of eight semester hours in either general biology or zoology or by courses of four semester hours each in zoology and botany, but not by botany alone."

It is evident, therefore, that however we may feel upon the advisability of a student acquiring his pre-medical training in the schools of pharmacy, some modification of these courses is essential to conform with the legal requirements in most of them. It is probable, however, that these schools would have little difficulty in expanding their biological courses.

*These subjects not compulsory, but "strongly urged."

† Includes Botany.

A. "A reading knowledge of French and German" required.

B. Must have had Latin as far as four books of Cæsar.

A. M. A. = Minimum requirements of the Council on Education of American Medical Association.

J. H. U. = Johns Hopkins University, entrance requirements.

It seems to me evident that the course leading to Bachelor of Science in pharmacy is, at least from the legal standpoint, with perhaps some modifications, capable of being used in the training of medical as well as pharmaceutical students. The question, however, of the relative desirability of obtaining this introductory knowledge in a college of so-called liberal arts or in a college of pharmaceutical science is one that involves many more features than the mere amount of time devoted to specified subjects.

ASSERTED SUPERIORITY OF COLLEGES OF ARTS.

The most concise statement that I know of, as well as authoritative, on the advantages of collegiate training, is that of Dr. Colwell, secretary of the Council of Pharmacy and Chemistry of the American Medical Association.

In an address before the Annual Congress of Medical Education last year, Dr. Colwell (*Journ. A. M. A.,* March 13, 1920) sums up:

"The advantages in requiring that the pre-medical work be taken in approved colleges of arts and sciences are:

"1. The physics, chemistry and biology are taught without reference to their special bearing on medicine. It is not known today what particular facts obtained in the study of these sciences will be most useful in the medical research of tomorrow.

"2. The quality of the pre-medical work is assured since it is carried on in courses leading to the degree of Bachelor of Science in reputable colleges of arts and sciences. This provides also a satisfactory standard for measuring the value of irregular or so-called 'equivalent' courses.

"3. The student is free to make a final choice of his life-work until he is best qualified to do so. He enters the classes leading to the science degree; he has a chance to compare notes with those studying for other callings, and may find that some other line of endeavor appeals to him more than medicine. If so, he can make the change without any loss of time, since his pre-medical courses are equally acceptable for admission to other departments. This freedom of choice is of great importance to the students, since from 10 to 30 per cent. change to some other calling before their two-year course is completed.

"4. Students now enter medical schools with the benefit of two years in the college atmosphere, the contact with students in other departments, the social life, and the athletics, which are bound to influence their entire lives.

"5. The arrangement is a safeguard against medical cults. It is

seldom that a student who had studied genuine science in his courses in physics, chemistry and biology will be misled by the fallacious claims advanced by unscientific cults."

On each of these arguments I should like to say a few words.

First.—That the physics, chemistry and biology are taught without their special bearing on medicine.

While I confess I cannot see great weight in this argument, it would be true, at least in a degree, of a course in a college of pharmacy and science. If the biology in such an institution were taught with any bias at all it would be as introductory to botany, a subject which is not recognized in our modern medical curricula.

Second.—That the quality of the pre-medical work is assured since it is carried in the courses leading to the Bachelor of Science in reputable colleges of arts and sciences.

The crux of this argument, of course, lies in the B. S. degree. If a college of pharmacy is prepared to and does give a B. S. degree, after a standard four years' course, is it not just as "reputable" as an academic institution that does the same? Why should the fact that one institution teaches philosophy and Greek, and the other pharmacy and materia medica, beside the science courses, militate either for or against their respectability?

Third.—The student is free to make a final choice of his life work until he is qualified to do so.

This means that when the student has entered the science course of a college he has not definitely committed himself to the study of medicine. If, however, at the end of one or two years of the college course which he has arranged as preparatory to the study of medicine, he decides he will become an engineer or an architect, he will have wasted a good deal of his time in studies that are of no direct value to him. But the chemistry and biology that he would learn in a college of pharmacy are just as useful to the lawyer as the chemistry and biology that he would learn in a college of art.

Fourth.—"The benefit of the college atmosphere, the contact of students in other departments, the social life and the athletics."

I confess that I am somewhat peeved whenever I come across this hoary tradition that association with your fellow man in a col-

lege hall has a different effect upon your character than association with the same man under any other circumstances. I believe the contact of the young man with his fellows is good for his development, but why that contact has to be sanctified by an ordained college of arts of science seems obscure.

As for the social life of a college that is a thing which varies with the individual school, not with the class of institution. When we contrast, for example, conditions at a great university like Columbia—with its thousands of pupils, relatively few of whom are in residence at the college, contending with the distractions of a great city in whose midst it is situated—to those at a little college like Haverford—located in almost rural surroundings, with its two or three hundred pupils practically all of them living on the campus—it seems ridiculous to talk about the atmosphere of college life as a fixed entity. If we grant for the sake of argument that there is some advantage to a boy being thrown into such intimate contact with two or three hundred of his fellows that he comes to know most of them by their first name, evidently it is not to be obtained in a large metropolitan university; on the other hand, if we believe that there is some advantage in having a common interest with two or three thousand fellows of his age with most of whom he has not even a nodding acquaintance, obviously, he cannot reap that benefit at any one of the hundreds of small colleges scattered throughout the country.

The "atmosphere" of the college class room is only too often still that of school-boy days: "If I can fool the teacher (or in this case professor), into believing that I have done work that I have not done that proves how smart I am." It does not seem to enter the mind of the pupil that he is there for the purpose of acquiring knowledge which is going to enable him to earn his living and to take his place among the workers of the world.

In striking contrast to this, in a college of pharmacy and science the presence in the class of men who are engaged in direct preparation for their life work helps to awaken a realization in the whole student body that play-days are for children, and to engender an atmosphere conducive to serious study. This mental attitude as well as the knowledge actually acquired, is a valuable asset to the student of medicine.

Fifth.—The arrangement is a safeguard against medical cults.

I can conceive of no atmosphere so hostile to the development of a medical cult as that of a college of pharmacy; I would not except from this statement even the halls of a medical school. Medical science is still based largely on theory; pharmacy is cold, indisputable facts and the man who has become accustomed to handling facts does not fall an easy prey to the weird speculations of the faddists.

There is one advantage that a college of Arts has over one of Pharmacy which appeals to me strongly; and that is the larger variety of secondary subjects offered to the student. Out of a required total of sixty semester hours the Council on Education insists on definite assignments for only thirty-four hours. In other words, nearly half of the student's course may be arranged to suit himself. If he be interested in history, or geology, or philosophy, he has a certain amount of time which can be devoted to these scholastic amusements. The Pharmaceutical school, however, offers him but litttle in the way of diversion, pharmacy, mathematics and Latin is about the sum total.

While, in all candor, we must acknowledge this is a real deficit, I feel that there are certain superiorities of the school of pharmacy and science which offset it.

Of the three fundamental subjects whose necessity is recognized by every one, there can be no question that the most essential is chemistry. It must be remembered today that in most medical schools there is absolutely no instruction in the subject of general chemistry; it is as much taken for granted that the student knows this subject as it is that he knows how to add and multiply (to be sure, I have met medical students, not a few, who were unable to work simple problems in percentage, but, they are laboring under a great disadvantage). A fair knowledge of general chemistry is an absolutely necessary antecedent to physiological chemistry, and the better the student is grounded in chemistry the easier it will be for him to gain a clear apprehension of pharmacology, physiology and many other branches.

I do not think that any one can seriously question the greater thoroughness of the chemical instruction given at a college of pharmacy and science compared to that of a college of arts and science. In the first place, if we compare, as typical, the number of hours

on the curriculum of college No. 1 we will note that there is three times the requirements of the Council on Education. Moreover, I am persuaded that the quality of the teaching is superior and this I say without derogation to the academic institutions. It is only reasonable to expect that a subject which occupies nearly one-third of the time of the students, and is taught by one-sixth of the faculty, of an institution should be more highly developed than at an institution where it forms a mere accidental or unimportant part of a great number of courses. Go out among the druggests and the doctors of the United States and see who has the better knowledge of chemistry! It is not merely because the druggist uses his chemistry, for I doubt if the pharmacist has much more need for chemistry in his daily occupation than the physician, but it is because the training in chemistry given in schools of pharmacy is more than equivalent to the entrance requirements for the medical school *plus* the chemistry taught in the medical school itself.

In physics and in biology the other two fundamental subjects, it is not unreasonable to suppose that the training will be at least equal, if not superior, in the school of pharmacy to that in the academic institution for the reason that both of these subjects are more or less fundamenal to the subsequent course in pharmacy.

We see, therefore, that the college of pharmacy is superior to the college of arts in the instruction in the required pre-medical subjects and I wish to go further than this and to show that the college of pharmacy offers certain advantages even in the elective studies. It is notorious that the weakest part of the medical curriculum is in materia medica. Time after time medical writers have stated that the reason that the manufacturers of proprietary mixtures flourish like the green bay tree is because the physicians of this country realize their inability to write a prescription properly. There is no better way to learn how to mix drugs, and how not to mix them, than to see the actual results of various combinations. In other words, while I would not assert that a practical acquaintance with pharmacy is necessary for the writing of prescriptions, I do believe it is of valuable assistance. That most teachers of pharmacology agree with this view is shown by the number of medical schools which include a course on pharmaceutical manipulations as part of their regular studies. But the time given to this course in the medical curriculum is totally inadequate to teach anything but the merest

smattering of general principles. Even if we grant that the instruction in pharmacy in the typical B. S. course of the schools of pharmacy and science is more than is actually needed by the physician, it would require much argument to make me believe that a knowledge of geology or calculus is more valuable to a doctor than a knowledge of pharmacy.

We should perhaps bear in mind in this discussion the student who is willing to spend four years in order that he may have a college degree and give some thought to the senior years of a college of pharmacy and science. In some of the institutions of this nature there is considerable variety in the subjects that are offered in senior years. The student may fit himself, for example, for an immediate position in industrial chemistry, or for the practice of pharmacy in one of its numerous branches. If, at the end of his sophomore year he is still intent upon the study of medicine, he has offered to him a variety of subjects such as materia medica, bacteriology, pharmaceutical chemistry, etc., which will be of direct assistance in his future medical career, that are not obtainable in the ordinary college of arts and science.

In conclusion I may sum up my views in the statement that while the courses leading to Bachelor of Science in Pharmacy are comparatively new and not yet developed to their highest efficiency the day is not far distance when medical colleges and legislators will no longer be justified in their discrimination in favor of the college of arts and science as against the college of pharmacy and science.

SOME MUCH NEEDED CHANGES IN THE PRACTICAL EXPERIENCE REQUIREMENT OF MANY PHARMACY LAWS.

By Lucius L. Walton, Ph. G., Ph. M., Pharm. D.

President, National Association of Boards of Pharmacy.

We have heard much of late in condemnation of the drug store experience required under our pharmacy laws, prerequisite to becoming licensed as pharmacist. A few writers would abolish this requirement altogether and substitute therefor a course in a college of pharmacy, while others, recognizing that the college does not and cannot replace the shop in every relation in which practical exper-

ience is essential, would have the candidate for license get a year of intense drug store training after graduation.

Some pharmacy laws make employment in a retail drug store, regardless of the kind of work performed, a qualifying prerequisite, but prohibit credit for practical experience in pharmaceutical work gained in other places. This is obviously unfair in more than one respect and is perhaps the strongest objection to the experience requirement of such laws.

The drug store, the college, and the hospital dispensary all afford opportunity to gain experience in pharmaceutical work directly related to the proper and safe conduct of the business of a retail drug store. In no single one of these places can the practical experience be acquired which a pharmacist should have. Therefore, our pharmacy laws should provide an experience prerequisite which is consistent in all respects with the pharmaceutical work carried on in these respective places. The experience which shall qualify should be that gained in pharmaceutical work only, and of such period of time as the economic conditions controlling the conduct of the drug business now may warrant.

When we consider carefully the changes in the kind and amount of pharmaceutical work performed in conducting the average retail drug store, from that existing when four years retail drug store experience was adopted in most States as *sine qua non* for admittance to pharmacy licensing examinations, and which requirement still prevails generally, a striking inconsistency in the requirement with present conditions is apparent.

Among the factors operating to reduce the actual pharmcaeutical work performed in the store and, therefore, making so long a term of store experience unnecessary for proper qualifications for conducting the retail drug business, may be noted the following: Competition of manufacturing pharmacists and chemists in the production of official products, and their ready to dispense special formulas or prescriptions now so much employed by physicians; tablet and biologic medication; legal standards for pharmaceutical products which must be determined by assay; laws and regulations controlling the use of alcohol and narcotics; increased compensation of clerks; limitation in the daily hours of service caused by labor laws; and the chain store.

Obviously, these have wrought their influence, also, in making

it unprofitable for retail pharmacists to make very many products. Some have caused the elimination of a great deal of the present medicinal armamentarium of physicians from the pharmacists' sphere of work in the store. The result is a gradual, serious and permanent curtailment in pharmaceutical operations and consequent loss of opportunity to gain practical experience therein in a retail pharmacy.

Comparing the conditions which confront the person taking up pharmacy with what they were when the present four years' practical experience requirement was established, the enforcement of this long term now is also inconsistent. At that time, and for a number of years thereafter, the young man entering the service of a pharmacist was not required to have any definite preliminary education. He began his experience by sweeping the store, washing windows, soda glasses, bottles and utensils used by others in compounding. He ran the errands, charged the soda water and mixed syrups for the fountain, also waited on soda water customers, none of which service is of a pharmaceutical character, unless it be learning to clean the utensils properly.

A year of such work and he was allowed to fold seidlitz powders, help roll compound cathartic pills, grind and powder some drugs (pharmaceutical work but seldom done in the pharmacy any more), and bottle some commonly used household remedies. The proprietor began to teach him some titles and direct his studies, if the former had time and was sufficiently interested. The first two years of service afforded very little opportunity to gain experience in compounding, or to perform any real pharmaceutical work. This part of the experience was gained during the last two years of apprenticeship.

Under these conditions the fathers were right in demanding a long term of service that before its termination might provide ample time in which to acquire a proper practical experience in all work pertaining to the business, and making it pre-requisite to registration.

But we live in a different day. Those entering pharmacy are high school boys or girls. Some are high school graduates and all must be very soon. The college of pharmacy is the best place in which to get practical experience in performing pharmaceutical operations. The menial work of the store is being done more or less by persons who do not aspire to become registered pharmacists,

because it has become too costly for pharmacists to pay the wages demanded by educated persons and permit them to employ their time in such service. Graduation from a reputable college of pharmacy is the legal requirement for pharmacy licensure in nearly half the States, and we are fast approaching the day when this will be required by all.

These changes in the economic conditions affecting the business and practice of pharmacy, and the education of the pharmacist, call for adjustment of the practical experience prerequisite of nearly all pharmacy laws. More particularly, however, for States which have adopted the college of pharmacy graduation prerequisite. In the latter pharmacists must be persons who have been taught systematically the properties and uses of drugs and poisons, and the art of compounding them, in a school properly equipped for giving such instruction. This of itself warrants a considerable reduction in the term of store experience, for this teaching responsibility no longer rests upon the preceptor in its entirety and the time required under store conditions in which to do it may be deducted justly.

For candidates desiring registration as pharmacist a short term of practical experience could be adopted at once in a number of States, without lessening in any important relation the qualifications of a person intrusted with legal authority to conduct a pharmacy.

Present conditions in States having the college of pharmacy graduation prerequisite warrant the adoption at once of a two years' practical experience requirement, confined to actual pharmaceutical work, one year of which shall have been gained in a retail pharmacy under the immediate supervision and instruction of a registered pharmacist.

With such requirement provision should be made for crediting experience gained in the dispensary of a public hospital, or other institution, and in the hospital corps of the U. S. Army, or U. S. Navy, if acquired under supervision of a registered pharmacist. But as all phases of pharmaceutical experience connected with the operation of a retail drug store are not available in either of these places, and in view of the short term to be required, a reasonable difference should be made in the credit as compared with that allowed for experience gained in the retail drug store.

This may be done by fixing a year's work in a retail drug store as a definite number of hours and placing an arbitrary value for the time in terms of UNITS. Relative values may then be given, as seem necessary and advisable, for pharmaceutical experience gained elsewhere. Moreover, such a system of crediting practical experience provides a uniform and satisfactory method for crediting practical experience which may be acquired through a few hours' pharmaceutical work in a pharmacy each day, or week, while the prospective pharmacist is attending high school.

RECENT ADVANCES IN PHOTOGRAPHIC PROCEDURES.

By Henry Leffmann, M. D.

Lecturer on Research, Philadelphia College of Pharmacy and Science.

Several interesting advances in photography have been made during the current year. Perhaps the most striking is the discovery by Lüppo-Cramer, of Munich, that some coal-tar colors will desensitize to a considerable extent without materially affecting the latent image, so that after exposure a plate can be immersed for a brief period in a solution of the color and then developed in a much brighter light than would be otherwise applicable. The color that has been found most satisfactory is phenosafranin, a red dye freely soluble in water. This is used in dilute solution (0.5 gram to 1000 cc.) the plate being immersed in it for about two minutes, rinsed, and developed. Ordinary plates may be developed by a feeble white light; panchromatic plates by a red light. The procedure has been found satisfactory for autochromes. The red tint imparted to the plate may be removed by washing, but in the case of autochromes the oxidation which is employed after the first development removes the color. A. & L. Lumière and Seyewetz, the active French investigators in this field, made extensive trials of other materials, especially coal-tar colors, but found none as satisfactory as phenosafranin. Curiously, it was found that apomorphia hydrochloride has a desensitizing action, but this is, of course, of no practical importance. Solutions of phenosafranin in water are now on the market under trade names. The French investigators just noted found that auran-

tia, a yellow dye-stuff, had a distinct desensitizing action, but practically only for plates that are not sensitive to red light. It was also found that the solution of aurantia in acetone, which was the commercial form first used, is decidedly irritating to the skin and the firm is now putting out a dilute solution in alcohol. It is not likely, however, that the phenosafranin will be displaced. For work with ordinary plates these desensitizers are not particularly valuable, but for work with autochromes and plates of wide range of sensitiveness, it is a great convenience to be able to work in an appreciable lighted room.

It has been incidentally found that phenosafranin is an accelerator of some developers and also a preservative of them. Formulas have recently been published in which phenosafranin is used in place of metol. Hydroquinone is especially stimulated by the dye. The quantity of dye used is small, but owing to the staining power, and the greater difficulty of observing the development in a colored solution, it is not likely that it will come extensively into use as a regular addition to the developer.

The subject of simultaneous developing and fixing, that is, combining the hypo with the developer has been brought forward rather prominently lately by some French workers. It is not new, having been described many years ago. Among the formulas given lately is one in which acetone is used, which is the only one with which I have had any approach to success. One French firm has put on the market a tube containing the materials for the procedure, but I have not had any success with it. The acetone procedure is objectionable on account of escape of acetone vapor from the bath during development, which is, of course, not only unpleasant, but dangerous.

Paper negatives have been introduced in Germany as a substitute for film and glass supports, both of which materials have increased enormously in cost. Paper negatives are not new, but have never been a prominent articles. In one of the older forms the paper was rendered translucent after the picture was finished and thoroughly dried by rubbing in castor oil, and skilful operators did very good work in this way. The German product is a gelatin film carrying the sensitive silver salt, so attached that after completion of the work and thorough drying, the film can be easily stripped off. As

this is very thin, it is possible to print it from either side, thus eliminating the double printing necessary in some cases to avoid a reversal of the relations of the picture. Two German firms are now furnishing these negatives and trial with one made by the Bayer Company and termed "Plattenfort" ("away with plates") gave good results. The opacity of the paper rendered development somewhat less satisfactory than with glass or film, but the gelatin stripped readily when the plate was dry. Great care must be taken not to remove it while appreciably moist as it will fold and adhere to itself. The lightness, comparative cheapness and ability to print from either side are advantages, but the low cost of glass and film negatives will restrict the sale of such of these products to countries in which such low prices do not obtain.

A revival of stereoscopy seems to be indicated. French photographers are especially active in the matter, and the current French photographic journals abound with advertisements of stereoscopic cameras some of which are very elaborate and costly. About half a century ago the stereoscope was very popular. A parlor was hardly thought complete without a box of views and a hand stereoscope.

A new developer, "Neol," has been lately announced by a German firm and is now in the American market. It is, of course, claimed that this practically eliminates the question of exposure, giving equally good pictures if this has been too little, too much or all right. Probably it has a wider range than those long used, but such claims are often subject to much discount. With the exception of metol, the importation of which is forbidden, the well-known Agfa products are now in full supply in the American market.

Considerable attention is being paid abroad to modification of projection apparatus to produce on the screen the appearance of solidity and perspective more strongly than by the usual methods, but no satisfactory result has as yet been obtained. Jenkins, of Washington, D. C., the well-known inventor of cinematographic apparatus, has recently perfected a machine for taking pictures at a very high speed.

ABSTRACTED AND REPRINTED ARTICLES

PROFESSIONAL TRAINING.*

Being the Address Delivered by SIR DAVID PRAIN, C. M. G., C. I. E., F. R. S., Etc., at the Opening of the Eightieth Session of the Pharmaceutical Society's School of Pharmacy, Bloomsbury Square, London, W. C., on October 5.

Many learned bodies make arrangements for special meetings at which anniversary addresses are delivered. The custom is supposed to serve intellectual ends. This School follows a practice which resembles that custom. But there is here a variation in method which suggests another motive. The proceedings today have so far had a moral object; they have shown the advantage of the patience that begets perseverance. Perhaps what remains may be meant to test your ability to display for fifty minutes the patience that leads to forbearance.

If so, I must warn you the test may be severe, for I have no reason to think myself qualified to deliver an Inaugural Sessional Address before this Society at the opening of your School. My excuse for venturing to speak in the presence of the Society is that my work has led me to study the natural history of some of your *materia,* and that I have been much indebted to its members for assistance while so engaged. My only warrant for addressing the School is that I have been invited to do so. The honour of that invitation is appreciated the more because it is undeserved.

As my official duties included investigation of the sources of certain drugs and actual production of others, I am encouraged to ask you to regard me as one of yourselves. The memory of this privilege increases my regret that experience does not entitle me to discuss problems belonging exclusively to pharmacy. But the accident to which I owe some relationship with your calling has led to like intercourse with others. Perhaps some of the information so acquired may interest you, especially as the vocation, outside my own, with which this intercourse has been most intimate, shares with pharmacy a common and contemporary origin.

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THE ORIGIN OF GARDENCRAFT AND PHARMACY.

The student of pharmacy often has occasion to appeal to unwritten history. He realises that her evidence, if harder to decipher, is more reliable than the written word. Unwritten history assures us that the earliest preoccupation of primitive man was as to what he might eat and wear. When these needs were first felt, man relied on wild Nature to supply them. As wild supplies became inadequate, a rudimentary husbandry had to be devised. This took the form of gardening; the hoe and spade antedate the plough. Modern refinement in husbandry is accidental; the original purpose of the cultivation of food and fibre-plants was to remedy defects and errors in diet and dress.

Horticulture has, then, some reason when it claims to have been founded by the first canonical patriarch. You may admit that claim without conceding that gardencraft is an older calling than pharmacy. The wants that led to the evolution of tillage induced more than discomfort; early man developed disease before he began to dig. The help of pharmacy may have been a secondary necessity; steps to meet that need were taken first. Though pharmacy and gardencraft originated at opposite poles in one primitive field of purpose, both callings are the immediate outcome of the same early solicitude.

STUDIES AND CURRICULA.

A School like this is not made by the building which houses it, but by the training it imparts. It is therefore natural if your thoughts, on the opening day of a new session, turn to the studies before you.

This is one of the subjects regarding which I cannot speak from experience. That is an advantage. Instead of being left to form erroneous impressions, I am able to turn for authoritative information to the brilliant Inaugural Address delivered by the President of the Society five years ago. Regarding pharmaceutical training as a whole, your predecessors were then reminded that schemes for compulsory curricula in pharmacy have been proposed at different times. Provision has been made in them for an irksome preliminary assessment of the knowledge you may have gained at school, and a fateful final scrutiny of the results of your professional train-

ing. For the period between these two examinations, such schemes usually postulate three separate disciplines:—

(1) A training in pure science;
(2) A pupilage in pharmacy; and
(3) A course of professional studies.

The President of the Society supplemented this interesting statement by explaining that in your School it had been the policy of the Society to reverse the sequence of the two preliminary disciplines. That circumstance is an encouragement to me. Much of my official work during thirty-five years has been overtaken with the help of horticultural colleagues trained in accordance with the policy so long observed by the Pharmaceutical Society. For sixteen years I have been closely associated with the training of student-gardeners in pure and applied science as a sequel to pupilage in the practice of their craft.

PROFESSIONAL TRAINING IN GENERAL.

The fact that the sequence of these preliminary disciplines has been the subject of thought on the part of your profession as anxious as that bestowed on the question by gardencraft may perhaps serve as my excuse if my remarks this afternoon relate to professional training in general.

Callings whose work involves the possession of "skilled hands" and a "trained eye" are often subjects of discussion as to the relative merits of "theory" and "practice." Though such comparisons are always legitimate, they are not often useful. They may, when instituted by members of the craft concerned, lead to improvement in practice and enlightenment as to principles. Critics to whom the practice of a craft is unfamiliar, display a tendency to think of "practice" and "theory" as being antagonistic. Experts in particular vocations know that, so far as their own work is concerned, conflict between "theory" and "practice" is impossible. Thanks to this saving circumstance, such discussions, even when they fail to do good, do no real harm.

There are certain crafts whose exponents seem to accomplish their allotted tasks without visible effort to master the principles that guide their acts. This does not affect the existence of these principles, and there is no calling in which the most consummate

master of its practice may not benefit by some knowledge of its theory. All of us, whatever our business may be, are indebted for our training to the same two teachers—Madame How, who tells us what to do in a given emergency; and Lady How, who enlightens us as to the true inwardness of her colleague's bidding. At the same time, although there is no vocation whose members can hope to "make good" until they have been fully instructed, the needs of most callings vary as to the extent to which acquaintance with their principles is essential, and as to the manner in which a knowledge of theory, as contrasted with practice, may be best imparted.

Even in crafts where a knowledge of underlying principles appears least essential, the question has another side. Every craftsman is the servant of his calling, with well-defined duties to it. But every calling has reciprocal duties towards its servants, who are entitled to take steps to ensure their fulfilment. In matters like this "Providence gives most help to those that help themselves," and there is no calling, whatever its nature or importance, whose members may not become better citizens if they think out the meaning of acts which habit, in their particular cases, has converted into "second nature."

VARIATIONS IN TRAINING: MEDICINE.

Modifications in training necessary at different times, and variations in training possible at a given time, are best understood if actual cases be considered. Medicine affords a good example of the one, husbandry of the other.

Public opinion insists that training in medicine shall go hand-in-hand with training in surgery. Though the duties in the two arts may differ, the law ordains that before a neophyte may practise either, he must be able to undertake both. The obligation to secure a "double qualification" involves complete professional training in the *fabrica* of surgery, the *institutes* of medicine, and the *materia* both arts share with pharmacy.

Originally, practical pupilage was the recognised procedure. It worked fairly well. The surgical *fabrica,* before the advent of antiseptics, were patent to the eye; success in practice depended on caution and manipulative skill. The medical *institutes* consisted largely of physiological and pathological postulates, which might be memorised; success in practice rewarded natural sagacity and saving

common sense. But pharmacy, when teaching intending practitioners how their *materia* should be used, incidentally proved to them how desirable it was that they should possess some acquaintance with chemical principles and with the characters and qualities of living organisms. When the *institutes* of medicine, discarding clinical authority, initiated the methods of direct observation and controlled experiment, students soon discovered for themselves that they could not grasp the facts underlying those subjective conceptions of the normal and the irregular they were expected to master, without some knowledge of physics and some understanding of the structure and functions of vital mechanisms.

Early journeymanship, originally spent at seats of learning discussing debatable questions and "wrangling" for degrees, was replaced by a system of "walking the hospitals." This developed into "a course of professional studies" which expanded at the expense of pupilage until the latter disappeared.

Medicine found that professional training gave better results than the practical instruction of pupilage, but that the opportunities for education, as contrasted with instruction, which pupilage affords, cannot be provided during a course of professional study. More was needed than a widening of the scientific foundation on which sound professional training rests. In order to "kill two birds with one stone" the "training in pure science" which future practitioners ought to undergo, was made a discipline distinct from the professional training which had to be imparted. The purpose was as sound as the theory on which it is based. But the extent to which it may be attained depends on the nature of the scientific discipline provided.

The policy interests you. Pharmacy sometimes pays it the compliment of advocating its adoption. This suggestion emanates from men of vision who forsee a time when, in pharmacy too, pupilage may be only a memory. When that day comes the need to follow medical example may have arisen. But while practical pupilage in pharmacy remains possible the need for a preliminary "course in pure science" is not clear, and the policy long adopted by the Society seems preferable. When Pharmacy has to devise a new policy, she may do well to study, rather than copy the example set by medicine. She may then, perhaps, avoid some far from trivial difficulties.

INSTRUCTION IN PURE SCIENCE.

When instruction in pure science forms an integral part of professional study, the principles of a science taught may be illustrated by facts connected with the calling the pupil is to follow. This involves some duplication; these facts must be referred to again when methods of practice are expounded. Such duplication possesses an educational value! it enables the same truth to be envisaged from different points of view.

Where instruction in pure science forms a prelude to professional training this advantage largely disappears. A decision has to be reached in advance whether scientific instruction be confined to the principles of a particular study or shall include the presentment of its salient facts. No middle course is feasible. The needs of different callings vary; it is not uniformly necessary that the master of a profession be an all-round scientific expert. Medicine and pharmacy, for example, do not think it essential that every future practitioner be as proficient in physics, chemistry, and biology as in his proper calling. Medicine believes that if her disciples can master the principles of these studies before professional training begins they may acquire familiarity with the special truths of each that bear on future practice, while being disciplined in the medical institutes. If this be true of those who practise medicine, it must also be true of competent teachers of medical practice. But it cannot apply to those who teach the institutes; such teachers, whether on the physiological or the pathological side, must be fully versed in physics, chemistry, and biology. Yet teachers of the institutes of any art should, like teachers of its practice, be recruited from among those who have studied that art and know its needs.

INTENSIVE TRAINING IN PURE SCIENCE.

When the institutes of medicine merely embodied the philosophical conclusions of clinical experience, no difficulty arose. Now that these institutes, like those of pharmacy, derive their inspiration directly from physics, chemistry, and biology, it is desirable that some who study medicine at a given time shall have made themselves as fully acquainted with the facts as with the principles of the sciences mentioned before commencing their professional course. There are few medical schools without any pupils who have undergone this intensive training in pure science. In some schools the

proportion of students so trained is steadily increasing. But their existence is due to idiosyncrasy; it is not the result of reasoned medical policy.

The effect of intensive preliminary scientific discipline becomes most marked during professional training in the institutes of an art or craft. Pupils who have only mastered the principles of the underlying sciences use the institutes as a means to the fuller understanding of practice; those disciplined in their truths display an inclination to serve the institutes. This is not unnatural. Some who find the physiological side of the institutes of medicine especially attractive show a tendency to omit the study of practice and to refrain from seeking a medical qualification. This is not from lack of interest in the diagnosis and treatment of disease. Much recent progress in both is due to the institutes rather than the practice of medicine; some noteworthy advances have emanated directly from those pure sciences on which physiology and pathology depend. The pathological side of the institutes now feels disposed to contend that neither in diagnosis nor in treatment can the surgeon or the physician be regarded as an expert.

Perhaps in leaving the provision of intensive preliminary training in pure science to hazard, medicine acts advisedly. The influence of such a training is subject to a potent limiting factor; the demand for physiologists and pathologists is restricted. Some who would gladly devote themselves to the service of the institutes feel compelled to study medical practice. This does not always modify their outlook. Disciples whose academic record might justify expectation of the highest rewards attending successful treatment of disease, devote themselves, after qualifying, to its prevention. They adopt this branch of their art, not so much because prevention was the primary purpose of medicine, as because medical investigation in this field is free from the philosophical shortcomings of clinical observation.

THE RAISON D'ETRE OF PRIMITIVE HUSBANDRY AND PHARMACY.

Alterations in outlook lead to modifications of policy. Primitive man, inadequately informed, distinguished health from sickness when he invented husbandry to maintain the one and pharmacy to alleviate the other. This archaic misunderstanding explains the belief, still at times entertained, that physiology and pathology

are "sciences." The logic of facts proves the institutes of medicine to be a homogeneous technology devised to apply physical, chemical, and biological truths; physiology and pathology are merely different aspects of one applied study. This new enlightenment has led medicine to revert to the strategy of early man, who regarded the maintenance of health as of more consequence than the treatment of illness. Unfortunately, the tactics primitive man adopted were not equal to his strategy.

Unwritten history tells us that the failure was not the fault of husbandry. When her hands were not tied by public opinion she gave evidence of her belief that the best way to prevent sickness is to destroy disease. The rustic simplicity of her methods did not lessen their scientific validity. As civility developed, the efficacy of the bonfire and the poleaxe in eradicating murrain and blight from herd and crop so impressed the community at large that they were copied by those in authority. The one was long applied by the Church to eliminate schism; the other is still at times employed by the State to extirpate faction. But as urbanity increased, public opinion manifested a dislike for their use in destroying human disease. This unreasoned objection did not modify the outlook of husbandry; satisfied that her policy was sound, she declined to preach a more comfortable doctrine.

THE BEGINNINGS OF MEDICINE.

Inability to shake the conservatism of husbandry was not the only difficulty early civilisation had to contend against. Pharmacy had originated as a craft directed first to warding off spells and afterwards to countering their effects. The pejorative significance of the Greek name for a member of your profession shows, however, that when historical chronicles began, an impression prevailed that pharmacy had gone over to the enemy. Unwritten history makes no suggestion of the kind; the belief, so generally entertained when culture dawned, that a pharmacist was necessarily a sorcerer and a poisoner, only proves that the effect of propaganda on public opinion was as powerful 4000 years ago as it is today. However this may be, early civilisation, unable to follow the advice of husbandry, ought to depend on that of pharmacy, was led to invent medicine, an art, the lexicographer tells us, "directed first to the prevention of diseases and afterwards to their cure." Limited to

defensive tactics, the new art at first hardly appreciated the strategy to which her evolution was indirectly due. With tireless zeal and constant courage, medicine, in the field of practice, has striven for four millenia to prevent sickness on defensive lines. But history delights to repeat herself, and medicine, apprised by her institutes as to man's original strategy, has at last adopted the tactics of husbandry. Passing from the defensive to a vigorous offensive, she now attempts to abolish disease.

THE SPHERE OF PHARMACY.

The secondary object of medicine being the cure of disease, pharmacy was no longer called upon to alleviate its symptoms. But pharmacy still had to supply the necessary *materia;* hence the friendly relationship between the new calling and the old, which teaches mankind how misleading propaganda may be. But while both callings are equally concerned with the virtues of their *materia*, pharmacy, with the wisdom which is one of her outstanding characteristics, concentrates her attention on their "qualities," and leaves medicine to study their "uses." On this scientific basis the respective responsibilities of the two professions towards their common *materia* are at present clearly defined. Should the new policy adopted by medicine succeed, some further adjustment may become necessary; its success may end medical practice and convert these *materia* into historic lumber.

The hope that the new medical dream may be fulfilled explains, though it does not justify, the complaint that pharmacy with her *materia* retards the advent of a sanitary millennium. Enthusiasm, even when infectious, hardly replaces fact. Already we hear warnings as to the risk we run when we carry sterilisation too far. We have, besides, to reckon with a system of public instruction which inhibits education so effectively that a constant supply of "conscientious objectors" to hygienic enactment is assured. Pharmacy, moreover, has powerful allies in chemical industries, with synthetic products to push and a subsidised reclamatory organisation. This may explain why "prescribing" and "dispensing" are not yet penal offences. This chemical support creates a risk that the "natural" *materia* of pharmacy, even if they remain officinal, may fall out of use, for medical fashion differs mainly from the sartorial kind in

its greater susceptibility to the influence of propaganda. Fortunately, it is equally fickle, and the danger may prove less instant than it seems.

TRAINING IN HUSBANDRY.

The question of training in husbandry differs from that in medicine, because gardeners and farmers decline to accept the medical view that practical pupilage is no longer necessary. But the question has given rise to two schools of thought. Many are still satisfied that practical pupilage affords all the training required. Others, whose watchword is "practice with science," believe that a course of training in pure science is desirable. But, unlike medicine, husbandry imagines that to impart such a training before professional instruction begins is "to put the cart before the horse." Whether in this, husbandry be right or wrong does not now concern us. Nor would it be safe to deduce either that husbandry has given less thought to professional training than medicine, or that medicine has reached conclusions sounder than those of husbandry. It is sufficient to remember that "circumstances may alter cases."

THE METHODS AND SCOPE OF HUSBANDRY.

It was no great merit on the part of husbandry to have realised in prehistoric days what medicine has only now discovered, that the surest way to prevent sickness is to abolish disease. Husbandry could employ methods medicine might not use. Nor is husbandry so conservative as early civilisation imagined. She knows quite well that whatever its ultimate benefits may be, the eradication policy is not conducive to immediate economy. She now prefers those newer modes of eliminating disease the medical institutes have devised. At the instance of her own institutes, husbandry at times takes the apparently retrograde step of attempting to treat where she used to destroy. Where, however, husbandry deserves credit is as regards the training she imparts to disciples destined to serve the institutes of husbandry as apart from its practice. These she subjects, as a matter of policy, to that intensive training in physics, chemistry, and biology, which in the case of those destined to serve the institutes of medicine is left to accident.

Within husbandry, however, horticulture and agriculture hold divergent views regarding technological advice. Horticulture, more

influenced by tradition than her younger sister, is indisposed to accept this from other than masters of gardencraft. Agriculture, taught to think she breathes a more enlightened atmosphere, does not urge her technological advisers to undergo practical pupilage in farming. A prejudice is not always unhealthy. Horticulture escapes the waste of time and effort occasionally experienced by agriculture owing to the consequences of defective tilth being mistaken for signs of disease. This type of mischance is one your profession must guard against when it comes to render sanitary science the assistance it now accords to medical practice. If the existing attitude of pharmacy, as contrasted with that of medicine and agriculture towards preliminary training in pure science be maintained, the risk in her case should be small.

Husbandry, like medicine, thinks her practice calls only for a training in the principles of the sciences that underlie its theory. But while husbandry never imparts such a training before professional instruction begins, those who arrange her curricula are divided in opinion as to whether the course in pure science, which all regard as desirable, may accompany or should follow practical pupilage.

THE CURRICULA OF AGRICULTURAL AND HORTICULTURAL SCHOOLS.

The curricula of most schools of agriculture are well adapted to the needs of those who have already mastered the craft of practical farming. In some cases, however, they reveal a belief that professional instruction, imparted concurrently with a training in scientific principles, may replace practical pupilage. But recent ordinances governing the work of such schools indicate that this belief has begun to waver; entrance is to be forbidden in future to those who have not already undergone a prescribed minimum of practical training.

The curricula of some horticultural schools seem also to manifest the hope that adequate practical and sound scientific training can be imparted simultaneously. But in gardencraft generally the belief is still held that the first business of the future gardener is to master his craft. Nothing, it is urged, should be permitted to impede or interfere with practical pupilage; only when this has been completed may inculcation of the principles that guide practice be undertaken.

FOUR TYPES OF TRAINING.

In callings like pharmacy or gardencraft we find, then, that there are, or may be, at least four distinct types of training. We may have practical pupilage alone; or we may have a training in pure science (1) as a prelude, (2) as a complement, or (3) as a supplement to practical pupilage. Let us consider briefly the leading characteristics of each type.

The part which pupilage unaided may play in the formation of character is perhaps less appreciated now than it once was. The first aim of pupilage is, by means of instruction and supervision, to make the pupil expert in his vocation. But where supervision is thorough the pupil undergoes education as well. Were this not so, pupilage might be almost as valueless as attendance at a school when games are forbidden. The system of teaching now prescribed has to subserve preparation for examinations. Teachers, through no fault of theirs, are largely limited to the task of imparting instruction, and the education their pupils obtain is mainly acquired unconsciously while at play. That the instruction given is good does not alter the fact that, where examinations must be prepared for, education suffers.

AN OBJECT-LESSON FROM THE EAST.

To supply evidence that pupilage may educate as well as instruct let me take you to the East. In an Indian botanical institution, where the horticultural officers were Europeans trained in science after pupilage in gardencraft, we had a staff of competent native gardeners. The needs of the institution being special, these gardeners had undergone pupilage there. That institution had been in existence over a century when, for the first time in its history, some of our most promising young native gardeners left to take service with an enterprising fellow-countryman whose business involved the use of sawmills and similar industrial appliances.

When asked what had led him to entrust gardeners with unfamiliar duties and pay them commencing salaries exceeding what they could ever hope to earn in their own calling, their new employer was quite frank. Good labour, he explained, was abundant; reliable supervision was scarce. At first his overseers were university graduates, trained in technical colleges. Yet there had been

accidents in his establishment. He had seen our men at work and thought their training had been good. "Since I employed your gardeners," he said, "there have been no accidents. They may know nothing about 'circular saws and steam-hammers,' but they carry out instructions and see that those under them do so."

But we need not go so far afield for evidence that pupilage alone may educate as well as instruct. The histories of pharmacy and gardencraft bear eloquent testimony to this. In both, the provision of a training in pure science, as apart from pupilage, is a thing of yesterday. The subject-matter of our Pharmacopœias and the contents of our gardens show that members of both crafts were addicted to observation and experiment, and were scientific workers without knowing it, before "natural studies" began.

SCIENCE BEFORE PRACTICE.

The arrangement under which a training in pure science precedes practical instruction is of interest to you, owing to its advocacy for pharmacy. In theory such an arrangement is admirable. The principles that underlie practice being already appreciated, the practice involved may be mastered more readily and with less delay. That the desired result is attained when the sciences have been fully mastered, there is no reason to doubt. Even in cases where only the principles of the sciences involved have been taught, advances in knowledge as well as mastery of the craft have followed. You know of such in the history of pharmacy; let me cite two from that of gardencraft. Hales as an undergraduate learned the principles of physics. Applying these to phenomena in his vicarage garden at Twickenham, he founded the study of plant physiology. Mendel, in the same way, applied the results of an early training in pure science when he founded the study of genetics in the monastic garden at Brunn. But in neither case were the scientific principles which led to such notable results acquired with the object of enabling these clergymen to improve natural knowledge or to master the practice of the craft they benefited. When a scientific subject is deliberately prescribed for the latter purpose, there is at times a tendency to think of its study in terms of some impending test. We can understand the relief felt when such an examination is over. But we can also understand, even if we disapprove, the tendency there sometimes is to forget not only the

anxiety but its cause. We know that the method of "science before practice" may be useful; that it is always of value we cannot pretend.

SCIENCE WITH PRACTICE.

The arrangement under which training in pure science goes hand-in-hand with practical instruction is also in theory sound. Here we hope to find practice illustrating the principles on which it is based, and science at the same time illuminating the application of these principles to practice. But the method violates an axiom applicable to most human affairs; it is usually best to do one thing at a time. What may and, at times, does happen is that pupils fresh from school and versed in the art of hoodwinking the enemies of education, put scientific principles acquired by rote to immediate use as mnemonics of manipulative details they may never have carried out. Where the destiny of such disciples is administrative or advisory, it needs the acid test of professional responsibility to show how specious an academic record may be. This, however, so far as the public interest is concerned, is a trifling disadvantage as compared with the moral effect of running practice and science in double harness, upon pupils whose interest in their proper calling is so intense that it absorbs most of their attention. These, in the examination room, at times fail to disentangle theory from practice; academic estimates of their attainments are apt to bear the relationship to reality which we might expect if ability to "ride to hounds" had to be judged by a horseman's mastery of the "antics of the circus."

SCIENCE AFTER PRACTICE.

The arrangement under which a training in pure science follows practical pupilage is so familiar to pharmacy that little need be said of it. The result of thorough pupilage in gardencraft, where my acquaintance with its effects is most intimate, is to make the knowledge imbibed a part of the pupil's individuality. The comprehension of the sciences whose principles underlie the practice of the calling is therefore simple. Formal illustrations of the doctrines a teacher imparts are hardly needed; such illustrations are already latent in the intellectual equipment of the pupil. On occasions the truths stated by the teacher may appear to diverge from the experience acquired by the pupil; difficulties thus created can be sub-

mitted by the pupil, and resolved by the teacher, out of hand. The advantage of a training in pure science after pupilage is over, lies, therefore, in the fact that such a training is not a course of instruction at all. It is throughout an unbroken process of education, full of pleasure and interest, alike to teacher and taught. You have before you an enviable opportunity. Benefit by that opportunity; such another may never come your way again.

Whether at the close of such a course of training there be a testing examination is immaterial. The teacher knows that nothing of the kind is required. If, for purposes of professional registration, ordinance prescribes such an ordeal, it becomes, for the pupil, an incident devoid of anxiety. The candidate is aware that whatever an examiner may ask him he can only be requested to evince knowledge already part of himself.

FUTURE DEVELOPMENTS.

Should circumstances eventually compel pharmacy, as they have compelled medicine, to abandon practical pupilage, it will be interesting to see what course your successors adopt. If, when that day comes, your chief work be to aid the institutes rather than the practice of medicine, the preliminary discipline in science which precedes professional training proper must be of the intensive character imparted to the technological assistants of husbandry; a training in science such as is adequate for medical or agricultural practice will not be sufficient. In imparting the necessary training pharmacy may, as regards physics and chemistry, rely, as agriculture and medicine do, on the aid of academic science. But so far as the necessary discipline in biology is concerned pharmacy will do well to follow the example of gardencraft and impart the scientific training on her own account.

The reason is obvious. In the field of organic study academic science finds that, for purposes of doctrine, facts relating to the structure and functions of the animal and the plant as vital mechanisms are more useful than those connected with the natural history of living organisms. But in pharmacy, as in gardencraft, these truths, valuable and essential as they are, constitute only a portion of the knowledge a pupil must master, and pharmacy, like gardencraft, will find that in this particular field of study, if she wishes the work to be done adequately, she must do it herself.

SEEKING THE TRUTH FOR ITS OWN SAKE.

Whatever the method of training that prepares us to follow our calling may be, we must not conclude, when the course is over, that our training is then at an end. There is a sense in which it may be said that only then does real training begin. The facts of life, whether these be as pleasant as I would wish you to find them, or as stern as they prove at times to most, are inexorable. Their lessons cannot be evaded; we must all educate ourselves to accept them. But we can carry our education further than this. It is not what facts bring home to us, but what we can extract from facts that really counts.

It is this that Philosophy has in mind when she urges us "to seek truth for her own sake." It is this that History has in view when she advises us to "improve natural facts for use or discovery." It is this that Academic Science intends when she urges the prosecution of what she terms "original research."

Sometimes the process has the advantage of adding to our knowledge of natural things. But this is of small moment as compared with the opportunity it provides us of learning our limitations, and of attaining what the Greeks regarded as the highest of human ambitions—that of "knowing ourselves." When your professional studies are over, but not until then, try the expedient. It will bring you its own exceeding great reward.

PLANT CONSTITUENTS.* †

By John Uri Lloyd, Phar. M.

CINCINNATI, O.

The good doctor to my right this morning asked me two questions; one was, "Why do we stand erect?" I told him, "I don't know." Some one, however, has answered that question by saying that there is a continuous self-balancing by unconscious move-

*The almost revolutionary studies of recent years made of plant structures as related to medicinal activity, makes this paper one worthy of being kept before the profession. We therefore take the liberty of reprinting from the *Eclectic Medical Journal*, December, 1920.—Editor.

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ments of the muscles. The problem has been made a study long ago, but is too far away from pharmacy for me to intrude.

The second question was, "In your laboratory you exhibited to us the Brownian Points, those eternally whirling, never-stop entities that seem to have motions of their own. May I ask, do they whirl in the night? Are they still when it is perfectly dark?" I had never thought of that problem, and I answered, "I don't know."

We do not know when we look through a film of liquid so thin that it separates two parallel glasses, that point, magnified under the ultra-microscope is seen to contain thousands of whirling points as bright as miniature stars. Likened may they be to twinkling star dust of space in the infinitely little. The question, "Do they whirl in the night?" is, so far as I know, unanswered. "Is it light that makes them whirl?" I don't know. I would like to say, in this connection, there is but one Chemist, and Alchemist, the Creator of all things. Let me illustrate. I have some specially made apparatus on this table. Whatever I desire to illustrate necessitates apparatus devised for that specific purpose.

Listen: The Alchemist I mention, by means of a little dirt, a little water and a little sunshine, brings life into a seed, and it becomes something unexplainable. A little dirt, water and sunshine, then comes a living sprout to grow into its own kind—blossom, fruit—and give of its life current vitality to a new crop of seeds that carry the parent stock to generation after generation. Not one life-carrying seed, even microscopic in size, has man, with all his apparatus and presumed scientific knowledge, ever formed.

Listen: Some years ago a talented biologist in Chicago announced that artificial life had been evolved in sea creatures by stimulating their eggs into life, "fertilizing" them by dilute saline liquids. Probably the public press grossly exaggerated his statements, or even perverted them into the assertion that he had *created* life artificially. At that date I chanced to be in New York City and defended the biologist as probably being misquoted, or under-quoted, and at the same time challenged the life creation argument. "If he makes the egg, then vitalizes it, I will accept that he has produced life artificially," I said. Has it ever been done? But to return to our subject.

Concerning Light and Heat.—Prof. Crooks discovered that if across an exactly balanced rod that rests on the point, be placed four

very light arms, the end of each carrying a small tissue, black on one side and white on the other, when the device is put in the light it begins to revolve. He announced (or at least accepted) that this movement resulted from the action of light striking the white side and being absorbed by the black opposite. After investigating it thoroughly, however, he decided that it was not light, but heat, that made the object move.

Now we know that force-driven materials are nothing marvelous. Electricity moves matter, heat moves matter, magnetism moves matter. There is nothing marvelous about it, unless we attempt to get at the origin of it all, then all is a marvel, a mystery. At a meeting of the American Pharmaceutical Association that met in Niagara Falls thirty-five years ago, Professor Carpenter, the famous English physiologist, was visiting Niagara Falls. We invited him to give a lecture before the Association. He had a friend in England renowned in a different line, in chemistry. His name was Crookes. These two friends, it has been stated (if memory serves correctly), became interested in the phenomena of spiritualism and concluded they would investigate it scientifically. Reading the same books, without bias, as they thought, studying the problem carefully, each with an open mind, Carpenter became a pronounced opponent of the cult, Crookes a devoted spiritualist. Possibly my memory is at fault concerning details, possibly my informant was mistaken in his narrative—it matters little, the text remains and is but a parallel of discordant views, good men hold in all walks of life.

This is what I ask you to accept in the direction of what, as an opinion I bring before you today. I am looking at the problem from one angle. Another year I may look at it differently. How easy it is to differ from one another, and how indiscreet to get out of humor with each other. We do not agree with our own selves after an interval of time.

Two weeks ago I sat in a little circle of men whose names are well known throughout the country. It was an evening dinner. Discussions arose, first one thing and then another. Finally I was called upon to say something. They had been talking on different problems connected with pharmacy and medicine. I said: "Gentlemen, I am here as an invited guest, as you know, a representative of, as I believe, a misunderstood, ostracized section in medicine. I have for a lifetime given my time and study largely to problems that concern the

therapeutic agents developed by members of this section. It may not be improper for me to add that our dominating ideal is that of service of humanity—service to anybody and everybody needing our help—yes, service to those who not only ignore us but too often seek to paralyze our efforts. The historian who studies the records of the past will discover that our aim has been to aid not only our associates, but those who consider it proper to become our enemies. I stand as one who believes himself by age and experience to be competent to balance problems, that in the passing along, where whilst passion prevailed, it was impossible to balance. I have learned to bear no personal animosity against any man who looks at a subject differently than myself. I have resisted what I thought to be wrong, but with no evil intent, for I have never hated any one. Long since have I divorced personalities from issues."

The next day one of the party met us and said: "Lloyd, do you know what impressed me most of all in your remarks? It was that policy of advocating an issue and forgetting the man—the principle of not making a personal antagonist of the party on the other side."

Let me now introduce the subject that I came before you to discuss. I have here something to show you, in the light before me today, but I crave the privilege of changing my opinion if future events lead to a reversed view.

For thirty or forty years in the experiments I have made with drugs, plants and plant structures, I have met continuously the fact that linked with each plant texture there was something present that under the influence of an alkali gave a yellow color. For example, strip a pawpaw of its bark and touch the white inner surface with a solution of potash—now it turns yellow. There is probably one rule in this as elsewhere, and that is the rule of exceptions. I hope to find one white blossom that will not turn yellow. If I do, the exception may be of help to the botanist, for it may be the forerunner of a class distinction.

For years this yellow phenomenon was before me, but I could not catch the material that produced it. About a year and a half ago I decided that if I isolated this yellow something that pervaded all plant tissues so linked with impurities as seemingly to defy isolation, it must be obtained from something that is white, something that does not carry a mass of extraneous material to contaminate the principle

desired. Then it occurred, why not use the petals of a *white* flower to get this *yellow* something?

The elder was then in bloom. These, I found, turned deep yellow with ammonia gas. I procured fifty pounds of elder flowers, put them in a percolator, made a tincture, and worked it by means of neutral solvents and excluders, to rid the product of the alcohol, chlorophyl and wax. I had five gallons of the chlorophyl-free liquid, and said to Mr. Miller, who was assisting me: "Place the jar in a cold situation and tomorrow morning I shall examine it." Next morning I tipped the jar very carefully, and all down the sides were little white concretions about the size of pin heads. It was the thing I have been seeking for years.

I took one of those pin heads to the laboratory and dropped it into distilled water and it did not dissolve. I added ammonia—behold! it immediately dissolved, the liquid turning deep yellow. It was only the size of a pin head, but there were thousands of them. And they kept increasing in size. The marvelous phase of this subject is I got eleven ounces (crude) of that substance out of that fifty pounds of elder flowers. Before that, by reason of faulty research, I could not get a grain from anything.

The first thought of a pharmacist is what value a new substance may have in medicine. Alas, the greater part of my work has been the repeated finding of something that had no value. I sent some of this material to Professor R. Adams Dutcher, University of Minnesota, requesting that he make a physiological examination of it. His preliminary report was to the effect that, according to a preliminary investigation, it has no physiological action. May I not ask, should a peculiarity of action be expected of a substance pervading plant tissues everywhere? [1]

In this cylinder I have distilled water, and I propose to put into the water a small amount of this material. Note that it settles to the bottom. It is perfectly insoluble. One grain shaken with a gallon of water apparently disappears, but if let stand until the next day, behold, it is all at the bottom. I now shake the mixture, and pour half of it into another cylinder, then add a little ammonia

[1] I had vitamines in mind. There was reason to hope that a general life supporter of plant life, serviceable to animals, could be found and isolated—not a poison of energetic action. This I accept, Dr. Dutcher demonstrated as a fallacy in the direction of this substance.

water—note the change in color to deep yellow. A very delicate reagent is it for an alkali. Let us now make both liquids yellow. Into one I pour dilute sulphuric acid, in excess, to destroy the ammonia. The liquid becomes colorless.

Now the question came to me, "Why is the white flower white when it has the yellow material in it in such quantity?" Then I figured to myself, it must be because the white petals carry also an acid which in contact with the yellow material makes it white. In other words, would the white flower be yellow if there was an alkali in the petal instead of an acid? Crushing the flower in a mortar with a little distilled water gave a sharp acid reaction. Blue litmus turned red at once. The acid was present.

The question arises, What is the use of this thing in nature? I think I comprehend the subject, but it is too great to try to bring before you today.

I am going to ask you to be charitable in what I have said concerning the theories I now hold. I may be right and I may be wrong. We can see this color change and we know that the petals hold organic acid. What of it? I don't claim that anything I have brought is new; quite the contrary. So far as I know, this experiment has not been made. In some literature unbeknown to me it may be explained. It doesn't matter whether it is new or old—it is a phase in plant economy that is a fact, and may be of service other than as a medicine.

I asked myself, Why could not the material be used to make a test paper? Why would not paper saturated with a solution of this material turn yellow with alkali and colorless with acid? I tried it and it worked. There is a shade between red and blue litmus which makes it difficult sometimes to quite determine the end reaction. There is no intermediate shade with this.

For example, let us now pour into these tumblers some water, and into the one put some ammonia and in the other dilute sulphuric acid. The paper I hold in my hand has been saturated with a weak solution of this material and dried. I dip it into the acid. See, it is colorless. Now I dip it into the ammonia; it instantly turns yellow.

You ask the name of this material. I call it *Eldrin.* But it may have been long known elsewhere and recorded under a different name or different terms.

A ROUTINE TEST FOR THE PRESENCE OF SULPHITES.*

By Albert E. Parkes.

The following method has been found to be a useful routine one for the detection of sulphites added as a preservative or bleaching agent to foodstuffs, confectionery, and other goods.

It is a modification of the combined methods of Schmidt (*Arbeiten aus dem Kaiserlichen Gesundheitsamte,* 21, 226) and of Winton and Bailey (*J. Amer. Chem. Soc.,* 1907, 29, 1499), and in practice has been found to be speedy, sensitive, and efficient, without the disadvantages of the better-known method of reduction by means of zinc to hydrogen sulphide (*U. S. Dept. Agr. Bul.,* 107, A. O. A. C.).

Ten grms. of the material, such as dried fruit or minced meat or fish, are incorporated with 10 to 20 cc. of water, by means of a pestle and mortar, and transferred to a small conical flask of about 50 cc. capacity. In the case of fruit-pulp, glucose-syrup or fruit juice, 10 cc. may be diluted, when necessary, with 10 to 20 cc. of water in the flask.

Ten cc. of dilute sulphuric acid of about 2N-strength and two or three small fragments of marble chips are now introduced into the flask, and the mouth immediately covered with a piece of starch paper (impregnated with a 1 per cent. starch solution), which should be screwed round the neck of the flask, and held in place with a rubber ring. The reason for the addition of the marble is to set up a gentle current of carbon dioxide to sweep out the oxygen and the liberated sulphur dioxide. The top of the paper is moistened with 1 drop of a 1 per cent. solution of iodine.

In the presence of any appreciable quantity of sulphites the blue stain on the starch paper will be immediately discharged by the sulphur dioxide. If traces only be present, it may take a few minutes. The action takes place in the cold; it may be hastened by leaving the flask in a warm place.

If the drop of iodine solution used be of the magnitude of 0.1 cc. it is obvious that the limit of sensitiveness of the test is the quantity of sulphur dioxide necessary to reduce the iodine and discharge the blue color—namely, 0.00025 grm.; and this is the limit usually found when using known amounts of sulphites, showing that prac-

*From *The Analyst,* October, 1921.

tically the whole of the liberated gas is driven out of the flask. This amount, if 10 grms. of the material be taken, would represent 0.0025 per cent. of sulphur dioxide, 0.175 grain per lb., or 1.75 grains per gallon respectively.

By using a weaker solution of iodine the test could be made more sensitive, but for a routine qualitative test the strength suggested makes it sufficiently delicate for the amounts usually met with.

Traces of hydrogen sulphide do not seriously interfere with this method, but in practice 1 cc. of a 5 per cent. solution of copper sulphate is added to the other ingredients when testing meat or fish, and this will retain as much hydrogen sulphide as is likely to be present.

DECOMPOSITION OF ATROPINE.*

By D. B. Dott.

Though it is a well-recognized fact that atropine or hyoscyamine is readily saponified by soda or baryta, forming tropine and tropate, there seems little information available as to the stability of the alkaloid under other conditions. The following experiments are of interest:

1. A weak solution of atropine sulphate was divided into three portions of 20 cc. each: (a) without any addition; (b) with 2 cc. dilute sulphuric acid; (c) with 6 cc. dilute sulphuric acid. After eighteen hours the alkaloid was determined in the usual way, the amount found being in each case exactly the same, 0.164 gm.

2. A weak solution of the atropine salt was divided into three equal volumes: (a) left plain; (b) with 2 cc. solution of ammonia; (c) with 6 cc. solution of ammonia. After eighteen hours the chloroform-soluble alkaloid was estimated:

(a) = 0.236 gm.
(b) = 0.173 gm.
(c) = 0.133 gm.

3. Solution of atropine salt, divided into three equal volumes; (a) left slightly acid; (b) with sodium carbonate in excess; (c)

*From *The Pharm. Journ. and Pharm.*, October, 1921.

with ammonia in slight excess. After forty-eight hours the alkaloid dissolved with chloroform, etc.:

(a) = 0.236 gm.
(b) = 0.161 gm.
(c) = 0.158 gm.

4. Solution similarly divided: (a) faintly acid; (b) 0.5 gm. sodium carbonate; (c) 0.5 gm. sodium bicarbonate. After sixteen hours, alkaloid was estimated as usual:

(a) = 0.158 gm.
(b) = 0.104 gm.
(c) = 0.144 gm.

5. Extract of belladonna, diluted, acidified and extracted by chloroform, as B. P. directs, in two equal volumes: (a) left acid for sixteen hours; (b) with excess of ammonia, left for some time:

(a) = 0.75 per cent. as atropine.
(b) = 0.63 per cent.

6. Extract of belladonna, watery acid solution divided into three equal volumes: (a) left for sixteen hours, and alkaloid quickly determined in usual way; (b) with excess of sodium bicarbonate; (c) with excess of ammonia, also left for sixteen hours before extracting the alkaloids:

(a) = 1.03 per cent.
(b) = 0.91 per cent.
(c) = 0.52 per cent.

7. Extract of belladonna, aqueous solution similarly divided and treated, the alkaloids being estimated in each case after forty minutes:

(a) left slightly acid = 1.00 per cent.
(b) excess of sodium bicarb. = 0.94 per cent.
(c) excess of ammonia = 0.86 per cent.

The results, no doubt, vary according to concentration of the solution, as well as to proportion of alkali to alkaloid. It might be worth while to try comparative experiments with hyoscyamine and atropine, as to rate of decomposition under the same conditions.

It is evident that the belladonna alkaloids are saponified to a considerable extent when their solutions are left for several hours in contact with ammonia or sodium carbonate, and to an appreciable degree even with sodium bicarbonate. It is true that when only a slight excess of ammonia is added, and the extraction with chloroform is promptly performed, the loss is very little, but the Pharmacopœia is silent on the question of excess, and gives no warning against delay in extracting. When the mixture becomes partially emulsified, and only slowly separates, the operation of extracting with chloroform is apt to be somewhat prolonged. One's attention is sometimes called to a matter which is more pressing, and an assay which has begun is left over for a while. In any case, it is safer to use sodium acid carbonate, and to avoid ammonia and alkaline carbonate when dealing with solutions of atropine or hyoscyamine salts. In the process given for assay of belladonna leaves, in which the drug is percolated with ether-chloroform mixture in presence of excess of ammonia, the result must be appreciably under the truth, as extraction by percolation is not a very rapid process.

MEDICAL AND PHARMACEUTICAL NOTES

CHENOPODIUM OIL.—Dr. Henry and Mr. Humphrey Paget, of the Wellcome Chemical Research Laboratories, contributed a paper to the meeting of the Chemical Society of London on Thursday, October 20, 1921, on this subject, in which it was pointed out that the oil has acquired considerable importance in recent years owing to its use as a remedy for hookworm in the tropics, especially by the International Health Board of the Rockefeller Foundation. The oil has been repeatedly examined since 1908, and it is well established that its principal constituent is ascaridole, $C_{10}H_{16}O_2$ a liquid peroxide to which the anthelmintic properties of the oil have been generally ascribed until Hall and Hamilton in the United States asserted that the lower boiling fractions of the oil, that is the terpene fractions, were more active in this respect.

The authors have therefore re-examined the oil with a view to isolating its components in a pure state and having them examined

pharmacologically and clinically. This work is being done by Dr. Wilson Smillie, at the Instituto de Hygiene, San Paulo, Brazil, who has already obtained a number of interesting results. The authors find that the oil is essentially a mixture of from 60 to 70 per cent. of ascaridole with hydrocarbons and a small quantity of the decomposition products of ascaridole. The hydrocarbons present are p-cymene, *l*-terpinene and a new terpene, which is probably a dihydro-p-cymene, boiling at 177-178, and yielding a well-crystallized tetra-bromide melting at 117° C. It is probably this tetrabromide, which was mistaken by Nelson for 1-limonene tetrabromide and led to his assumption that the oil contained 1-limonene. The two are, however, quite distinct, the new tetrabromide being optically inactive though derived from a lævorotatory terpene and forming monoclinic crystals, whilst 1-limonene tetrabromide is lævorotatory and forms rhombic crystals. No evidence of the presence of sylvestrene, safrole, camphor or phelandrene, all of which have been suggested as present in the oil, could be obtained. Minor constituents are butyric acid and methyl salicylate. In the course of oxidizing the hydrocarbon fraction it was found that *l*-terpinene yields two forms of *ld*-dihydroxy- -methyl-*l*-isopropyladipic acid $CCOH.C(Me)OH.$-$CH_2.CH_2.C(Pr)OH.COOH$ instead of a single form only as stated by Wallach and that both forms are optically inactive.

The clinical results already available show that the constituent of value for the treatment of hookworm is ascaridole and that the hydrocarbon fraction, when pure, has no action on hookworm. The products formed by the decomposition of ascaridole by heat are also quite inactive in this respect.

Tests of Pine Product Disinfectants.—The disinfectant action, method of production, and chemical properties of pine oil and pine-distillate product emulsions are reported in United States Department of Agriculture Bulletin No. 989, by the Bureau of Chemistry and the Insecticide and Fungicide Board, as the result of a bacteriological and chemical study of these products.

The work was undertaken for the purpose of determining the physical, chemical and disinfectant properties of pine-oil and other pine-distillation products, in order to secure data to assist in the detection of the adulteration of commercial products as well as to check up the statements concerning the deterioration of pine-oil dis-

infectant and its peculiar behavior against certain pathogenic organisms.

The results reported will be of interest to bacteriologists and chemists who are concerned with testing pine-oil and pine-distillate product emulsions and to hospital authorities, dentists, sanitarians and others who use these products as disinfectants. The investigators found that these products, while effective against *B. typhosus,* are not effective against *M. aureus* and *B. anthracis,* and should not, therefore, be used for general disinfecting purposes. When using pine-oil emulsions against *B. typhosus* it is safer for practical purposes, according to the report, to employ a solution five times the strength capable of killing the organism in five minutes. Thus, a product showing by the Hygienic Laboratory method a killing power of $1/500$ should be used in a $1/100$, or 1 per cent. dilution. If the product will not give a dilution of such a concentration and remain completely emulsified, it should not be used as a disinfectant.

Copies of Bulletin No. 989, giving data upon which conclusions are based, may be had upon application to the Division of Publications, Department of Agriculture, Washington, D. C.

SCIENTIFIC AND TECHNICAL ABSTRACTS

Determination of Sugar in Normal Urine. — Benedict and Osterberg (*Jour. Biol. Chem.,* 1921, *48,* 51), describe the following method which in their hands, after extensive trial has given good results. The sample should be diluted so that the sp. gr. is not above 1030. Fifteen cc. are mixed with 1 gram of purified bone charcoal (see below), shaken occasionally during ten minutes, and filtered through a dry filter. Not more than 3 cc. of the filtrate should be used for the determination, and the amount used should contain about 0.001 gram sugar. The volume should be measured into a large test tube which is marked at 25 cc., and if less than 3 cc. of the sample is used water should be added to make up to this volume. One cc. of a 0.6 per cent. of picric acid solution prepared from the dry acid, 0.5 cc. of a 5 per cent. sodium hydroxide solution are added and then 5 drops of a 50 per cent. acetone solu-

tion. This last solution should be not over twenty-four hours old as it does not seem to keep well. The contents of the tube are well mixed and promptly placed in boiling water. The acetone solution should, therefore, be added just before the immersion is made, and all solutions should be added so that no portion falls on the side of the tube. The heating continues for about fifteen minutes. A comparison solution is prepared by heating simultaneously a solution of pure glucose (presumable dextrose is intended), using 3 cc. of such solution containing 0.001 of the sugar. Such a solution will keep indefinitely if mixed with little toluene.

The bone black is prepared by boiling 250 grams of commercial bone black in 1500 cc. of dilute hydrochloric acid (1 to 4 volumes water), for thirty minutes, filtering off hot and washing until the filtrate is not acid. The material is then dried and powdered. The highly absorbant animal charcoals are not suitable. The purified bone black should be tested to prove that it has no sugar absorbing power. The standard and sample must correspond in sugar content within close limits, so that with samples containing very small amount of sugar a more dilute standard will be found more satisfactory. H. L.

Antidotes to Cocaine Poisoning.—A child, ten years of age, who had been poisoned with a 10 per cent. solution of cocaine applied to the nose, exhibited strong motor excitation accompanied by pupil dilatation, with very frequent pulse, and numbness. Hoping to counteract the effects of the cocaine, the author injected 0.01 gm. of pilocarpine with the idea of compensating the cocaine effect and also to produce a rapid sweating and diuresis which would be likely to remove the poison rapidly. The result was apparently very rapid; in a few minutes the patient became quieter, and in ten minutes was conscious. A repetition of the procedure upon dogs was not successful. It appeared that the conditions of sweating were not comparable, nor were the symptoms of cocaine poisoning in dogs controlled by amyl nitrite and physiological saline. The trial of sleeping drugs was then resorted to—chloral hydrate, veronal, and scopolamine hydrobromide. Of these, veronal proved to be the best, especially when given intravenously.—A. Hofvendahl (*Biochem. Zeitschr.*, 1921, 117, 55, through *The Pharm. Journ. and Pharm.*, 1921, 287.)

Pharmacological Evaluation of Convallaria Majalis.—Dr. S. G. Zondek finds that convallaria contains an unusually high per cent. of glucoside, which acts on the heart. The activity, measured on frogs, is five times that of digitalis. The flowers are the most active part of the plant. The M. L. D. of convallamarin per gram of frog was found to be 0.015 mgm. Extracts made with water, 70 per cent. alcohol, and absolute alcohol all showed about the same activity. The relative potency of the herb, flowers and roots is reported as 6000, 10,000 and 5000. The stability of the tincture was investigated with the result that two samples of tincture made from different specimens of the herb and one made from flowers, after standing one year showed only 10 per cent. change, one sample showing an increasing activity. The author concludes that it is possible to standardize tincture of convallaria accurately by the frog method and that the drug is worthy of more extended use.—*Archiv. Exp. Path. u. Pharmakol.* 90, pp. 277-87 (1921).

J. F. C.

New Color Reactions of Quinine.—An (aqueous?) solution of a quinine salt is treated in a test tube with chlorine water. To this there is added in such a way that it will form the lower layer, a very dilute ammonia or caustic alkali solution which is saturated with sodium chloride in order to increase its density. At the interface a violet red ring appears while the lower layer is colored green, if ammonia was used, or yellow with potassium or sodium hydroxides. In the erythroquinine reaction, a solution of quinine treated with either chlorine water or bromine water, and then with potassium ferrocyanide, gives a red color. The author, attributing this reaction to the formation of ferricyanide, has modified it as follows: The quinine solution is added to a slight excess of either chlorine water or bromine water, and ammonia is added to slight alkalinity. A green (thalleoquin) color results. If a few drops of freshly prepared solution of potassium ferricyanide are added the green color changes to red, and on shaking the mixture with chloroform, the red color passes into the lower layer.—(D. Ganassini, *Bolletino chim. farm.*, v. 60, p. 141 [1921].)

J. F. C.

The Reaction of Baljet; Identification of Digitalis Glucosides.—The reagent consists of equal parts of 1 per cent. alcoholic picric acid, and 10 per cent. sodium hydroxide free from carbonate. In the presence of glucosides it gives a red or orange color due to isopurpuric acid. The reaction is apparently due to the presence of a lactone group. Wischo concludes that this reaction cannot be used for the quantitative determination of digitalis glucosides because the different glucosides in digitalis galenicals give colors of variable intensity. The strophanthin colors are constant.—(Fr. Wischo., *Zeit. d. allg. oesterr. Apoth. Verein.*, v. 35 [1921].)

J. F. C.

Cinchophen, Tolysin and Renal Excretion.—Phenylchinchoninic acid and the methyl ester of p-methylphenylcinchoninic acid (tolysin) exercise a general stimulating effect on kidney excretion. The action is most marked in the case of uric acid, but it is possible to demonstrate a similar action in the case of urea and chlorides, provided cases are selected with a slightly high blood concentration of these substances.—(Myers and Killian, *J. Pharmacol. Exp. Ther.*, 18, p. 213 [1921].)

J. F. C.

Detection of Veronal and Veronal Derivatives.—Veronal and its derivates may be detected in the urine or intestinal contents when it is present in very small amounts by the following procedure. Two ml. of the urine are shaken out with 2 ml. of ether, the ether is separated and evaporated on a watch glass when veronal, if present, is left in rings which, under the microscope, are seen to consist of needle-shaped crystals. The identification may be checked by adding a few drops of a solution of mercuric oxide in 2.5 parts of nitric acid.—(Zimmermann., *Apoth. Ztg.*, v. 35, p. 382 [1921].)

J. F. C.

Odorless Petroleum.—This may be prepared by adding 100 gm. of chloride of lime to 4.5 litres of petroleum and shaking. The excess of chlorine may be removed by pouring off the oil onto quicklime, shaking, letting settle and pouring off the clear oil.—(*Pharm. Post*, v. 54, p. 175 [1921].)

J. F. C.

To Distinguish Oubain From Strophanthin.—A few crystals of the substance are added to a mixture of 4 to 5 ml. of concentrated hydrochloric acid and a small pinch of resorcin in a test tube and the mixture is heated at 60-70 in a water bath for several minutes. Strophanthin gives a rose coloration; ouabain gives no color.—(A. Richaud, *J. de Pharm. Chemie.*, v. 113, p. 161 [1921].)

J. F. C.

NEWS ITEMS AND PERSONAL NOTES

The augmented faculty of the Philadelphia College of Pharmacy gathered together at the festive board, on Monday evening, October the 24th, at Kugler's Restaurant. This initial gathering marks the opening of the series of monthly faculty meetings which have been the custom for some years past. The new members of the faculty were introduced and were given the glad hand of welcome. The monthly meetings of the faculty have been inspirational and educational and are zealously attended by every member of the instructional corps of the College. Scientific papers are usually read by individual members of the faculty, these papers subsequently appearing in the College publication, The American Journal of Pharmacy.

The course of lectures on popular subjects was opened to a well attended house on October 6, 1921, when Dr. Henry Leffmann, Lecturer on Research at the College, delivered an address on "The Chemistry of Other Worlds." The wisdom of the persons who suggested this course of lectures was reflected in the high-class type of audience that attended this first address. Prof. Freeman P. Stroup, Professor of Chemistry at the College, on October 20, 1921, delivered the second lecture on "Petroleum Products and Their Modern Uses." A working model of oil well machinery, hand-carved by the lecturer, was an interesting exhibit at this lecture which was also listened to by an appreciative audience.

The rehabilitated and renovated College found its annual sessions opened to record breaking classes of students. The elevation of pre-requisite requirements seems not to have materially altered the number of apprentice pharmacists. It was possible, however, to give

comfortable accommodation in laboratory and lecture rooms to all who matriculated.

Fraternities of the College are more active than they have been for many years, and the friendly competition for candidates has been more keen than ever. Their social functions are already under way. The Kappa Psi Fraternity's Smoker on Monday evening, November 7th, proving a success from every viewpoint. The Phi Delta Chi, in their new home at 2021 Green Street, also held a well-attended smoker at the house on Wednesday evening, November 9th.

Professor E. Fullerton Cook presented a paper on the Tenth Decennial Revision of the United States Pharmacopœia before the New York Branch of the American Pharmaceutical Association, evening of November 14th. Other members of the Revision Committee were also present to discuss the revision and its progress.

Dr. Clement B. Lowe, Emeritus Professor of Materia Medica, was presented by the faculty with an engraved gold hunting case watch, a token of their appreciation of his long and honorable connection with the College teaching staff. Professor Lowe, beloved of the students, is no longer teaching at the College, but still maintains an active interest in College affairs and is a regular attendant at the College meetings. The new Professor of Materia Medica, Dr. Horatio Wood, Jr., has already become very popular with his classes.

Dean Charles H. LaWall, along with his multitudinous duties, manages to find time to engage in activities which take him some distance from his usual habilitation. For instance, November 10th, at Atlantic City, N. J., he lectured on "Food Adulteration" before their Kiwanis Club. Then at the meeting of the American Public Health Association in New York, we find him reading a paper on "Unsuitable Forms of Cheap Candies" before the Section on Foods and Drugs.

BOOK REVIEWS

"Common Sense Drug Store Advertising." By Bert Kahnweiler.

There has recently appeared as a contribution to the literature of commercial pharmacy, a 61-page book on the advertising problems of the retail druggist. The author himself is a successful business man and a graduate of pharmacy. He is an enthusiast and justifiably so, since he attributes his own success to the business-getting character of his advertisements.

The book is essentially inspirational, if one may use that term in the commercial world. It at least is stimulating to that sense of business acumen which must be well developed in a commercialized drug store and which is one division of the formula of success. Mr. Kahnweiler has pointed out advertising principles that are practicable and some of the pitfalls to avoid. The book is interesting reading and adds to the growing commercial library of the department-store type of pharmacy.

For sale by the Carey Printing Company. 475 Tenth Street, New York City. Price, $2.00.

E. F. C.

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SUBJECTS.

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Four preliminary numbers were published at different times until in 1829, when the publication of the regular volumes began. Since then the publication has been uninterrupted. During the period from 1829 to 1852 four numbers were published annually, except in 1847, when five numbers were published. From 1853 to 1870 six numbers were published. Since this time twelve numbers have been published annually.

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